Cocker's

ARITHMETICK:

BEING

A plain and familiar Method, sutable to the meanest Capacity, for the full understanding of that incomparable Art, as it is now taught by the ablest School-Masters in City and Country.

COMPOSED

By *Edward Cocker*, late Practitioner in the Arts of Writing, Arithmetick, and Engraving. Being that so long since promised to the World.

PERUSED and PUBLISHED

By *John Hawkins*, Writing-Master, near St. *George's* Church in *Southwark*, by the Author's correct Copy, and commended to the World by many eminent Mathematicians and Writing Masters in and near *London*.

This Impression is corrected and amended, with many Additions throughout the whole.

Licensed *Sept.* 3. 1677. *Roger L'Estrange.*

LONDON,

Printed for *T. P.* and are to be sold by *John Back* at the *Black Boy* on *London-Bridge*, 1691.

Ingenious COCKER! (Now to Rest thou'rt Gon
Noe Art can Show thee fully but thine own
Thy rare Arithmetick alone can show
Th' vast Sums of Thanks wee for thy Labours owe

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TO his much Honoured Friends *Manwaring Davies*, of the *Inner-Temple*, Esquire; and Mr. *Humphrey Davies* of St. *Mary Newington-Butts*, in the County of *Surrey*,

John Hawkins, As an Acknowledgment of unmerited Favours, humbly Dedicateth this *Manual of Arithmetick*.

To the READER.

Courteous Reader,

I Having the Happineſs of an Intimate Acquaintance with Mr. *Cocker* in his Life time, often ſollicited him to remember his Promiſe to the World, of Publiſhing his Arithmetick, but (for Reaſons beſt known to himſelf) he refuſed it; and (after his Death) the Copy falling accidentally into my hands, I thought it not convenient to ſmother a work of ſo conſiderable a moment, not queſtioning but it might be as kindly accepted, as if it had been preſented by his own hand. The Method is familiar and eaſie, diſcovering as well the Theorick as the Practick of that neceſſary *Art* of Vulgar *Arithmetick*: And in this new Edition there are many remarkable Alterations for the benefit of the Teacher or Learner, which I hope will be very acceptable to the World: I have alſo performed my Promiſe in Publiſhing the Decimal Arithmetick, which finds encouragement to my Expectation, and the Bookſellers too. I am

Thine to ſerve thee,

John Hawkins.

Mr.

Mr. *Edward Cocker's*

PROEME or PREFACE.

BY the ſacred Influence of Divine Providence, I have been inſtrumental to the benefit of many, by virtue of thoſe uſeful Arts, Writing *and* Engraving: *And do now with the ſame wonted alacrity caſt this my Arithmetical Mite into the Publick Treaſury; beſeeching the Almighty to grant the like Bleſſing to theſe as to my former Labours.*

Seven Sciences *ſupremely excellent,*
Are the chief Stars in Wiſdom's Firmament:
Whereof Arithmetick *is one, whoſe Worth*
The Beams of Profit and Delight ſhines forth;
This crowns the reſt; this makes man's mind complete;
This treats of Numbers, and of this we treat.

I have been often deſired by my intimate Friends to publiſh ſomething on this Subject; who in a pleaſing Freedom have ſignified to me that they expected it would be extraordinary. How far I have anſwered their Expectations, I know not; but this I know, that I have deſigned this Work not extraordinary abſtruſe or

profound, but have by all means possible within the Circumference of my Capacity, endeavoured to render it extraordinary useful to all those whose Occasions shall induce them to make use of Numbers. If it be objected that the Books already published, treating of Numbers, are innumerable, I answer that's but a small wonder, since the Art is infinite. But that there should be so many excellent Tracts of Practical Arithmetick extant, and so little practised, is to me a greater wonder; knowing that as Merchandise is the Life of the Weal-Publick; so Practical Arithmetick is the Soul of Merchandise. Therefore I do ingenuously profess, that in the beginning of this undertaking, the numerous Concerns of the honoured Merchant first possessed my Consideration: And how far I have accommodated this Composure for his most worthy Service, let his own profitable Experience be judge.

Secondly, For your Service, most excellent Professors, whose Understandings soar to the sublimity of the Theory and Practice of this noble Science, was this Arithmetical Tractate composed; which you may please to employ as a Monitor to instruct your young Tyroes, *and thereby take occasion to reserve your precious moments, which might be exhausted that way, for your more important Affairs.*

Thirdly, For you, the ingenious Off-spring of happy Parents, who will willingly pay the full Price of Industry and Exercise for those Arts and choice Accomplishments, which may contribute to the Felicity of your future State; For you, I say, (ingenious Practitioners) was this Work composed, which may prove the Pleasure of your Youth, and the Glory of your Age.

Lastly, For you the pretended Numerists of this vapouring Age, who are more disingenuously witty to propound unnecessary Questions, than ingenuously judicious to resolve such as are necessary; For you was this Book composed and published, if you will deny your selves so much as to invert the streams of your Ingenuity, and by studiously conferring with the Notes, Names, Orders, Progress, Species, Properties, Proprieties, Proportions, Powers, Affections and Applications of Numbers delivered herein, become such Artists indeed, as you now only seem to be. This Arithmetick ingeniously observed, and diligently practised, will turn to good account to all that shall be concerned in Accompts. All whose Rules are grounded on Verity, and delivered with Sincerity. The Examples are built up gradually from the smallest consideration to the greatest. All the Problems or Propositions are well weighed, pertinent and clear, and not one of

them

them throughout the Tract taken upon trust therefore now,

Zoilus and *Momus* lie you down and dye,
For these Inventions your whole force defie.

Edward Cocker.

Courteous

Courteous Reader,

BEing well acquainted with the deceased Author, and finding him knowing and studi-us in the Mysteries of Numbers and Algebra, of hich he had some choice Manuscripts, and a reat Collection of Printed Authors in several Languages. I doubt not but he hath writ his Arithmetick sutable to his own Preface, and orthy acceptation, which I thought to certifie on request to that purpose made to him that wish-th thy Welfare, and the Progress of Arts.

John Collens.

Novemb. 27th 1677.

This Manual of Arithmetick is recommended to the World by Us whose Names are subscribed, viz.

Mr. *John Collens,* Mr. *James Atkinson,* Mr. *Peter Perkins,* — Math.	Mr. *William Mason,*
Mr. *Rich. Laurence,* Senior,	Mr. *Steph. Thomas,*
Mr. *Eleazer Wigan,*	Mr. *Peter Storey,*
Mr. *Rich. Noble* of *Guilford,*	Mr. *Benj. Tichbourn,*
Mr. *William Norgate,*	Mr. *Joseph Symmonds,*
	Mr. *Jerem. Milles,*
	Mr. *Josiah Cuffley,*
	Mr. *John Hawkins.*

And generally approved by all ingenious Artists.

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CHAP.

CHAP. I.

Notation of Numbers.

1. ARITHMETICK is an Art of Numbring or Knowledge, which teacheth to number well, (*viz.*) he Doctrine of Accompting by Numbers. nd there are divers ſpecies and kinds of A- ithmetick and Geometry, the which we do ntend to treat of in order; applying the rinciples of the one to the Definitions of he other: For as Magnitude or Greatneſs is he ſubject of Geometry, ſo Multitude or Number is the ſubject of Arithmetick; and ſo, then their firſt Principles and chief undamentals, muſt have like Definitions; r at leaſt, a Semblable Congruency.

2. Number, is that by which the quan- ity of any thing is expreſſed or numbred; s the Unit is the number by which the quan- ity of one thing is expreſſed or ſaid to be

one, and two by which it is named two, and $\frac{1}{2}$ half by which it is named or called half, and the Root of 3 by which it is called the Root of 3, the like of any other.

3. Hence it is that Unit is number, for the part is of the ſame matter that is his whole, the Unit is part of the Multitude of Units, therefore the Unit is of the ſame matter that is the multitude of Units; but the matter of the Multitude of Units is number, therefore the matter of Unit is number: for elſe if from a number given, no number be ſubſtracted, the number given remaineth; let three be the number given, from which number ſubſtract or take away one (which as ſome conceive is no number) therefore the number given remaineth; that is to ſay, there remaineth three, which is abſurd.

4. Hence it will be convenient to examine from whence Number hath its Riſe or Beginning: Moſt Authors maintain that Unit is the beginning of Number, and it ſelf no number; but looking upon the Principles and Definitions in the firſt Rudiments of Geometry, we ſhall find, that the Definition of a Point is in no way congruous with the Definition of an Unit in Arithmetick; and therefore one, or Unit muſt be in the bounds or limits of number, and conſequently

ſequently the beginning of number is not to be found in the number one; wherefore to make number and magnitude congruent in Principles, and like in Definitions, we make and conſtitute a Cypher to be the beginning of number, or rather the medium between increaſing and decreaſing numbers, commonly called abſolute or whole numbers, and negative or fractional numbers, between which nothing can be imagined more agreeable to the definition of a point in Geometry; for as a point is an adjunct of a line, and it ſelf no line, ſo is (o) Cypher an adjunct of number, and it ſelf no number: And as a point in Geometry cannot be divided or increaſed into parts, ſo likewiſe (o) cannot be divided or increaſed into parts; for as many points though in number infinite do make no line, ſo many (o) Cyphers, though in number infinite do make no number. For the line A B cannot be increaſed by the addition of the point C, neither can the number D be increaſed by the addition of the (o) Cypher E, for if you add nothing to 6, the Sum will be 6, (o) neither increaſing nor diminiſhing the number 6; but if it be granted that A B be extended or prolonged to the point C, ſo that A C be made

A——B
C
D 6
E o
ſum 6

A—B—C

D E
6 o } 6

a con-

in a continued line, then A B is increased by the addition of the point C, in like manner if we grant D 6 be prolonged to E (0) so that D E (60) be a continued number making 60, then 6 is augmented by the aid of (0) as to the constituting the number (60) sixty; and farthermore that one or unit is material and a number, and that (0) is the beginning of number is proved by all Authors although indirectly, for the Tables of Sines and Tangents prove one degree to be a number, because the Sine of 1 degree is 174524 (the Radius being 10000000) and the beginning of that Table is (0) and to it answereth 00000, *&c.*

5. Hence it is that number is not quantity discontinued, for all that which is but one quantity, is not quantity disjunct; (60) sixty as it is a number, is one quantity, *viz.* one number (60) sixty; therefore as it is number, it is not quantity disjunct; for number is some such thing in Magnitude, as humidity in Water; for as humidity extends it self through all and every part of Water, so number related to Magnitude, doth extend it self through all and every part of Magnitude. Also as to continued Water doth answer continued humidity, so to a continued Magnitude doth answer a continued number. As the continued Humidity of any

any intire Water, ſuffereth the ſame Diviſion and Diſtinction that his Water doth; ſo the continued Number ſuffereth the ſame Diviſion and Diſtinction that his Magnitude doth. From all which Conſiderations we might enlarge a farther Digreſſion concerning Number and Magnitude, by comparing the Definitions of the one with the Principles of the other, for having found a (0) Cypher to be anſwerable in Definition to a point in Magnitude, we may very well conclude that number may be congruent to a line; as alſo the Figurative Number to be conſonant in Definition with a Superficies, and Solid, *&c.* in the order of Geometrical Magnitudes.

6. The Characters or Notes by which Numbers are ſignified, or by which a Number is ordinarily expreſſed, are theſe following, (*viz.*) 0 Cypher or Nothing, 1 One, 2 Two, 3 Three, 4 Four, 5, Five, 6 Six, 7 Seven, 8 Eight, 9 Nine. The Cypher, which though of it ſelf ſignifieth nothing (*viz.*) expreſſeth not any certain or known quantity, but is the Beginning, Radix, or Root of Number, and the other nine Figures, or Characters are called ſignificant Figures or Digits.

7. In Numbers of any ſort, two things

are to be conſidered, (*viz.*) Notation and Numeration.

8. Notation teacheth how to deſcribe any number by certain Notes and Characters, and to declare the value thereof being ſo deſcribed, and that is by Degrees and Periods.

9. A degree conſiſts of three figures, *viz.* of three places, comprehending Units, Tens and Hundreds, ſo 365 is a degree, and the firſt figure (5) on the right hand, ſtands ſimply for its own value, being Units or ſo many ones (*viz.*) five; the ſecond in order from the right, ſignifies as many time tens as there are unites contained in it, (*viz.*) ſixty; the third in the ſame order ſignifies ſo many hundreds as it contains Units, ſo will the expreſſion of the number be, three hundred ſixty five; alſo 789, is ſeven hundred eighty nine, *&c.*

10. A Period is when a number conſiſts of more than three figures, or places, and whoſe proper order is to prick or diſtinguiſh every third Place beginning at the right hand, and ſo on to the left; ſo the number 63452 being given, it will be diſtinguiſhed thus 63'452, and expreſſed thus, ſixty three thouſand four hundred fifty two; likewiſe 4.578.236.782, being diſtinguiſhed, as you ſee will be expreſſed thus, four thouſand

thouſand five hund. ſeventy eight millions, two hundred thirty ſix thouſand, ſeven hundred eighty two.

11. Number is either Abſolute or Negative.

12. An Abſolute, or Intire, Whole, Increaſing Number, is that which by annexing of another Figure or Cypher it becomes ten times as much as it ſtood for before; and if two Figures or Cyphers be annexed, it makes it a hundred times more than it ſtood for before, *&c.* as if you annex to the Figure 6 a Cypher, then it will become (60) ſixty: ſo if two Cyphers be annexed, then it will be (600) ſix hundred; and if you do annex to it a (4) four, then it will be (64) ſixty four; and if you annex (78) ſeventy eight, it will be then (678) ſix hundred ſeventy eight, and ſo on: By annexing more Figures or Cyphers, it will increaſe in a decuple proportion *ad Infinitum.*

13. A Negative, or Broken, Fractional, Decreaſing Number, is that which by prefixing a Point or Prick towards the left hand its value is decreaſed from ſo many Units, to ſo many tenth parts of any thing; and if a point and (0) Cypher, or a digit be prefixed, it will be then ſo many hundred parts, and if a Point, and two Cyphers or Digits be prefixed, its Value is decreaſed to be ſo

many thousandth parts ; as if you would prefix before the Figure 3 a point (.) or prick thus (.3) it is then decreased from 3 Units or Integers, to (3) three tenth parts of an Unit or Integer ; and if you prefix a Point and Cypher thus (.03) it is decreased from 3 Integers to 3 hundredth parts of an Integer, and by this means 5 *l.* absolute by prefixing of a point will be decreased to 5 *l.* Negative, which is 5 tenth parts of a pound, equal in value to 10 shillings, and so by prefixing of more Cyphers or Digits, its value is decreased in a decuple proportion *ad infinitum.* As in the following Scheme, or rather order of Numbers, we have placed (0) Cypher in its due place and order, as it is both the beginning and medium of Number ; for going from (0) towards the left hand, you deal with Intire, Absolute, Whole, Increasing Numbers.

Increasing Numbers. | *Decreasing Numbers*

29	876	543	256	2 1 0 1 2	345	678	976	3
mm	mmm	mmm	mmm	CXUXC	mmm	mmm	mmm	m
mm	mmm	mmm	CX		XC	mmm	mmm	m
mm	mmm	CX				XC	mmm	m
mm	CX						XC	
X								

But going from (0) the place of Units towards the right hand, you meet with Broken, Negative, Fractional and Decreasing Num-

Numbers. And hence it follows that Multiplication increaſeth the product in Abſolute Numbers, but decreaſeth the product in Negative Numbers; alſo Diviſion decreaſeth the Quotient in whole Numbers, and increaſeth it in Negative or Fractional Numbers.

14. An Abſolute, Intire, Whole, Increaſing *Number*, hath always a point annexed towards the right hand, and therefore,

15. A Negative, Broken, Decimal, Decreaſing *Number*, hath always a point prefixed before it towards the left hand. When we expreſs Integers, or whole *Number*, as 5 *pounds*, 5 *feet*, 26 *men*, we uſually annex a point, or prick after the Number

l. feet. men. inch.

thus, 5. 5. 26. 347. But when we expreſs Decimals, or Numbers that are denied to be entire, as decreaſing *Numbers*, we do commonly prefix a point or prick before the ſaid Decimal or decreaſing *Number* thus, (.3) that is 3 Tenths, or three Primes .03, that is 3 hundredths, or 3 Seconds.

16. A whole or abſolute *Number* is an Unit or a compoſed Multitude of Units, and it is either a Prime, or elſe a compounded *Number*.

17. Prime *Numbers* amongſt themſelves are thoſe which have no multitude of Units

for a common meaſurer, as 8 and 7, or 1 and 13, becauſe not any multitude of uni can equally meaſure or divide them witho a Remainder.

18. Compound *numbers* amongſt them ſelves are thoſe which have a multitude o units for a common meaſurer, as 9 and 12 becauſe 3 meaſures them exactly, and ab breviates them to 3 and 4.

19. A broken *number* commonly called Fraction, is a part or parts of a whole *num ber*, *viz.* a part of an Integer, as $\frac{1}{3}$ one thir is one third part of an unit.

20. A broken *Number* or Fraction, conſiſt of 2 parts, *viz.* the Numerator and the De nominator.

21. The Numerator and Denominator of a Fraction, are ſet one over the other, with a line between them; and the Numerator i ſet above the line, and expreſſeth the parts therein contained.

22. The Denominator of a Fraction is the inferior *number* placed below the line, and expreſſeth the number of parts into which the unit or Integer is divided; as let $\frac{3}{4}$ be the Fraction given, ſo ſhall 3 be the numerator, and doth expreſs or *number* the multitude of parts contained in this Fraction, for $\frac{3}{4}$ is a Fraction compoſed of Fourths, or Quarters, and the Figure 3 in *numbring* ſhews

ſhews us that in that Fraction there are 3 of thoſe fourth parts or quarters; alſo in the ſame Fraction $\frac{3}{4}$, 4 is the *denominator*, and doth expreſs the quality of the Fraction, *viz.* that the whole, or integer, is here divided into 4 equal parts.

23. A broken *number* is either proper or improper; *viz.* proper, when the *numerator* is leſſer than the *denominator*; ſo $\frac{3}{4}$ is a perfect proper Fraction: But an improper Fraction hath its *numerator* greater, or at leaſt equal to the *denominator*; thus, $\frac{1}{8}$ is an improper Fraction: the Reaſon is given in the Definition.

24. A proper broken *number*, is either *Simple*, or *Compound*; *viz. Simple*, when it hath one *Denomination*, and *Compound*, when it conſiſteth of divers *Denominations*. If $\frac{3}{4}l.$ $\frac{6}{12}l.$ $\frac{25}{100}l.$ were given, we ſay they are either of them ſingle or *ſimple* Fractions becauſe they conſiſt but of one *numerator* and one *denominator*; but if $\frac{3}{4}$ of $\frac{9}{12}$ of $\frac{35}{100}$ of a pound Sterling were given, we ſay that it is a *compound broken Number*, or *Fraction*, becauſe the expreſſion and repreſentation, conſiſteth of more *denominations* than one; and ſuch by ſome are called *Fractions of Fractions*, and they have always this Particle (of) between them.

25. When

25. When a single *broken Number* or *Fraction*, hath for his *denominator* a *number* consisting of a Unit in the first place towards the left hand, and nothing but Cyphers from the Unit towards the right hand, it is then the more aptly and rightly called a decimal Fraction; under this head are all our decreasing *numbers* placed, and in our 13th *Definition* called Negative, and by that order there prescribed, we order them to be *Decimals* by signing a point or prick before them, or the *numerator* rejecting the *denominator*: Therefore according to our last Rule, $\frac{5}{10}$ $\frac{5}{100}$ $\frac{25}{100}$ $\frac{25}{1000}$ are said to be *Decimals*; and a *Decimal Fraction* may be expressed without its *denominator*, (as before,) by prefixing a point or prick before the *numerator* of the said *Fraction*, and then shall the former *Fraction* $\frac{5}{10}$ and $\frac{25}{100}$ stand thus .5 and .25.

But oftentimes as in the second and 4th Fractions $\frac{5}{100}$ and $\frac{25}{1000}$, a prick or point will not do without the help of a cypher or cyphers prefixed before the significant figures of the *numerator*, and therefore when the *numerator* of a *decimal Fraction*, consisteth not of so many places, as the *denominator* hath cyphers, fill up the void places of the *numerator*, with prefixing cyphers before the significant figures of the *numerator*, and then

then sign it for a *Decimal*, so shall $\frac{5}{100}$ be .05 and $\frac{25}{1000}$ will be .025 and $\frac{71}{10000}$ will be .0072. Now by this we may easily discover the *denominator* having the *numerator*; for always the *denominator* of any *decimal Fraction* consists of so many Cyphers, as the *numerator* hath places, with a Unit prefixed before the said Cyphers, *viz.* under the point or prick.

26. A *Decimal Number* or *Fraction*, is that which is expressed by *Primes*, *Seconds*, *Thirds*, *Fourths*, &c. and its Number decreasing. Here instead of *Natural* and *Common Fractions*, as $\frac{3}{4}$ of a thing, we order the Thing or Integer into *Primes*, *Seconds*, *Thirds*, *Fourths*, *Fifths*, &c. that our expression may be consonant to our former order.

27. In *Decimal Arithmetick*, we always imagine (and it would be very commodious if it were really so) that all entire Units, Integers, and Things are first divided into ten equal parts, and these parts so divided we call *Primes*; and secondly, we divide also each of the former *Primes* into other ten equal parts, and every of these Divisions we call Seconds; and thirdly, we divide each of the said Seconds into ten other equal parts, and those so divided we call *Thirds*; and so by decimating the former and subdecimating

mating these latter, we run on *ad infinitum*.

28. Let a Pound Sterling, Troy-weight, Averdupois-weight, Liquid Measure, Dry Measure, Long Measure, Time, Dozen or any other thing, or Integer be given to be *decimally* divided; in this Notion premised, we ought to let the first division be *Primes*, the next division *Seconds*, the next *Thirds*, &c. So one pound Sterling being 20 shillings, which divided into ten equal parts, the value of each part will be two shillings; therefore one *Prime* of a pound Sterling will stand thus(.1) which is in value two shillings, Three *Primes* will stand thus (.3) and that is in value 6 shillings. Again a *Prime* or .1 being divided into ten equal parts, each of those parts will be one *Second*, and is thus expressed, (.01) and its value will be found to be 2 *d.* farthing and $\frac{6}{10}$ of a farthing; and so will .05 signifie one shilling, or five *Seconds*. And if .01 be divided into ten other equal parts, each of those parts so divided will be *Thirds*, and will stand thus .001, and its value will be found to be 96 of a farthing, or $\frac{96}{100}$ of a farthing; and 009 *Thirds* will be 2 *d.* and .64 of a farthing, or $\frac{64}{100}$ of a farthing, &c. So that .375 *l.* will be found to represent 7*s.* and 6 *d.* for the 3 *Primes* are 6 shillings, and the 7

Seconds

Seconds are 1 s. 4 d. and $\frac{8}{10}$ of a penny, and the five *Thirds* are 1 penny and $\frac{2}{10}$ of a penny, both which added together make 7 s. 6 d.

29. If you put any bulk or body, repreſenting an Integer, if it be *decimally* divided; then the parts in the firſt decimation are *Primes*, the next *Seconds*, and the next decimation is *Thirds*, the next *Fourths*, &c. As let there be given a Bullet of Lead, or ſuch like, whoſe weight let be 50 *l. Troy* this call an Unit, Integer, or thing, then with the like weight and matter, make 10 other, the which together will be equal to 50 *l.* and will weigh each of them 5 *l.* a piece, take of the ſame matter, and equal to 5 *l.* make 10 more, then each of thoſe will weigh 6 ounces a piece; alſo if again you take 6 ounces, and thereof make 10 other ſmall bullets, each of them will weight 12 penny-weight *Troy*; and thus have you made *Primes*, *Seconds*, and *Thirds*, in reſpect of the integer containing 50 *l. Troy*-weight. So that 5 *Primes* is equal to the half maſs, and 2 *Primes* and 5 *Seconds* is a quarter of the maſs; and therefore 1 of the firſt diviſion, 2 of the ſecond diviſion, and 5 of the third diviſion, will be equal in weight to $\frac{1}{2}$ a quarter of the maſs, and contain 6 *l.* and 3 ounces.

30. When

30. When a *decimal Fraction* followeth a whole *Number*, you are to ſeparate or part the *decimal* from the *whole Number* by a point or prick; ſo if .75 followed the *whole Number* 32, ſet them thus 32.75. You will find that divers Authors have divers ways in expreſſing mix'd *Numbers*, as thus, $32|\underline{75}$ or 32 $\frac{75}{100}$ or $32.\ddot{7}5$ but you will find that 32.75 thus placed and expreſſed is fitteſt for Calculation.

31. A mix'd *Number* hath two parts, the whole and the broken; the whole is that which is compoſed of Integers, and the broken is a Fraction annexed thereunto. So the mix'd *Number* 36 $\frac{8}{12}$ being given, we ſay that 36 is the whole *Number*, which is compoſed of Integers, and the $\frac{8}{12}$ is the broken *Number* annexed, which ſheweth that one of the former Integers (of that 36) being divided into 12 parts, this $\frac{8}{12}$ doth expreſs 8 of thoſe 12 parts more belonging to the ſaid 36 Integers.

32. *Denominative Numbers* are of one, or of many, and thoſe are of divers ſorts and kinds, *viz. Singular* Called unit, as 1; and *Plural* called Multitude; as, 2, 3, 4, 5; *Single* of one kind only, called *Digits*, as 1, 2, 3, 4, 5, 6, 7, 8, 9 and *Compounds* of many, as 10, 11, 12. *&c.* 102, 367, *&c.*

Proportional, as Single, Multiple, Double, Triple,

Triple, Quadruple, *&c.* Denominate as pounds, shillings, pence; Undenominate as 1, 2, 3, *&c.* Perfect as 6, 28, 496, 8128, 130816, 2096128, *&c.* Whole parts are equal to the numbers, imperfect, unequal, and more in the summ, as 12 to 1, 2, 3, 4, 6. Imperfect, unequal, and less than the summ, as 8 to 1, 2, 4. Numbers Commensurable and Incommensurable, as 12 and 9 are Commensurable because 3 measures them both.

But 6 and 17 are Incommensurable because no one common *Number* or *Measure* can measure them; Linear in form of a line, as.......... Superficial in form of a Superficies or plane, as .:⁘:· or ⁞⁞ ⁞⁞ *&c.* and number cubical or solid in form of a Cube. These two latter are otherwise called figurative numbers: There are also other numbers called Tabular, as Sines, Tangents, Secants, *&c.* Others that be called Logarithmetick or borrowed numbers, fitted to proportion for easie and speedy Calculation of all manner of Questions.

CHAP.

CHAP. II.

Of the Natural Division of Integers, and the several Denominations of their Parts.

1. BEfore we come to Calculation, or the ordering of *Numbers*, to operate any Arithmetical Question proposed, we will lay down Tables of the denomination of several Integers; and after that (having mentioned the several Species or kinds of Arithmetick) we shall immediately handle the Species of Numeration, which are the main Pillars upon which the whole Fabrick of this Art is built.

Of *Money*, *Weights*, &c.

2. The least Denomination or Fraction of Money used in *England* is a Farthing, from

from whence is produced the following Tables, called the Table of Coin, (*viz.*)

1 *Farth.*	make	1 *Farthing*
4 *Farth.*		1 *Penny*
12 *Pence*		1 *Shilling*
20 *Shill.*		1 *Pound*

and therefore

l.	s.	d.	qrs.
1	20	12	4
1	20	240	960
	1	12	48
		1	4

The firſt of theſe Tables, *viz.* that on the left hand is plain and eaſie to be underſtood, and therefore wants no directions. In the ſecond Table above the line you have 1 *l.* 20 *s.* 12 *d.* 4 *qrs.* whereby is meant that 1 pound is equal to 20 ſhillings, and one ſhilling is equal to 12 pence, and one penny is equal to 4 farthings, under the line is 1 *l.* 20 *s.* 240 *d.* 960 *qrs.* which ſignifies 1 pound to contain 20 ſhillings, or 240 pence, or 960 farthings; in the ſecond line below that is 1 *s.* 12 *d.* 48 *qrs.* the firſt ſtanding under the denomination of ſhillings, whereby is to be noted that one ſhilling is equal to 12 pence, or 48 farthings, and likewiſe that below that, 1 penny is equal in value to 4 farthings; underſtand the like reaſon in all the following Tables of Weight, Meaſure, Time, Motion, and Dozen.

Of

Of Troy-Weight.

3. The least Fraction or Denomination of weight used in *England*, is a grain of Wheat gathered out of the middle of the Ear, and well dried ; from whence are produced these following Tables of Weight, called *Troy-weight*.

32 *Grains of Wheat*	make	24 *Artificial grains*
24 *Artificial grains*	make	1 *Penny-weight*
20 *Penny-weight*	make	1 *Ounce*
12 *Ounces*	make	1 *Pound Troy-weight*

And therefore

l	*oun.*	*p. w.*	*grains.*
1	12	20	24
1	12	240	5760
	1	20	480
		1	24

Troy-weight serveth only to weigh Bread, Gold, Silver, and Electuaries ; it also regulateth and prescribeth a Form how to keep the Money of *England* at a certain Standard. The Goldsmiths have divided the ounce *Troy-weight* into other parts, which they generally call Mark-weight; the denominative parts thereof are as followeth, *viz.* A Mark (being an ounce Troy) is divided into 24 equal parts, called Carects and each Carect into 4 grains ; so that in a Mark

Mark are 96 Grains; by this weight they distinguish the different fineness of their Gold, for if to the finest of Gold be put 2 Carects of Alloy (which is of Silver, Copper, or other baser Metal, with which they use to mix their Gold or Silver to abate the fineness thereof) both making when cold but an Ounce, or 24 Carects, then this Gold is said to be 22 Carects fine, for if it come to be refined the 2 Carects of alloy will fly away and leave only 22 Carects of pure Gold, the like to be considered of a greater or lesser quantity; and as the fineness of Gold is estimated by Carects, so the fineness of Silver is distinguished by ounces; for if a pound of it be pure, and looseth nothing in the refining, such Silver is said to be twelve ounces fine, but if it loseth any thing, it is said to contain so much fineness as the loss wanteth of 12 ounces, as if it lose an ounce it is said to be 11 ounces fine, and if it lose 1 ounce 14 penny weight, then it is said to be 10 ounces 6 penny-weight fine, and that which loseth 2 ounces 4 penny-weight 16 grains, is said to be 9 ounces 15 penny-weight 8 grains fine, *&c.* the like of a greater or lesser quantity.

Of Apothecaries Weights.

4. The *Apothecaries* have their Weights

deduced

deduced from Troy-weight, a pound-*Troy*, being the greatest Integer, a Table of whose division and sub-division followeth, *viz.*

1 *pound*	makes	12 *ounces*	
1 *ounce*		8 *drams*	
1 *dram*		3 *scruples*	
1 *scrup.*		20 *grains*	

And therefore

l.	*oun.*	*dram.*	*scrup.*	*gr.*
1	12	8	3	20
1	12	96	288	5760
	1	8	24	480
		1	3	60
			1	20

5. Thus much concerning *Troy-weight*, and its derivative weights, which (as was said before) serveth to weigh Bread, Gold, Silver, and Electuaries, now besides *Troy-Weight* there is another kind of weight used in *England*, commonly known by the name of *Averdupois*-weight, (a pound of which is equal to 14 ounces 12 penny weight *Troy-weight*,) and it serveth to weigh all kinds of Grocery-Wares, as also Butter, Cheese, Flesh, Wax, Tallow, Rozen, Pitch, Lead, and all such kind of Garbel, the Table of which weight is as followeth.

The

The Table of Averdupois Weight.

4 quarters of a dram	make	*1 dram*
16 drams		*1 ounce*
16 ounces		*1 pound*
28 pounds.		*1 quarter of a hundred*
4 quarters		*1 hund. weight, or 112 l.*
20 hundred		*1 Tun.*

And therefore

Tun	*C.*	*qrs.*	*l.*	*oun.*	*dra.*	*qrs.*
1	20	4	28	16	16	4
1	20	80	2240	35840	573440	2293760
	1	4	112	1792	28672	114688
		1	28	448	7168	28672
			1	16	256	1024
				1	16	64
					1	4

Wool is weighed with this Weight, but only the Divisions are not the same; a Table whereof followeth.

A Table

A Table of the denominative Parts of Wool-weight.

7 *Pounds*	make	1 *Clove*
2 *Cloves*		1 *Stone*
2 *Stone*		1 *Todd*
6 *Todd* 1 *Stone*		1 *Wey*
2 *Weyes*		1 *Sack*
12 *Sacks*		1 *Last*

And therefore

Last	*Sacks*	*Wey*	*Todd*	*Stone*	*Cloves*	*l.*
1	12	2	$6\frac{1}{2}$	2	2	7
1	12	24	156	312	624	4368
	1	2	13	26	52	364
		1	$6\frac{1}{2}$	13	26	182
			1	2	4	28
				1	2	14
					1	7

Note that in ſome Countries the *Wey* is 256 *l. Averdupois*, as is the *Suffolk-Wey*; but in *Eſſex* there is 336 *l.* in a *Wey*.

6. The leaſt denominative part of liquid Meaſure is a pint, which was formerly taken from *Troy-weight*, (a pound of Wheat *Troy-weight* making 1 pint of liquid Meaſure) but in regard of the difference between the Brewers and the Farmers of His Majeſty's Exciſe

Excise concerning the Gauging of Vessels, occasioned by the different Opinions of Artists, concerning the solid Inches in a Gallon; it was lately decided by Act of Parliament, the Statute making 282 solid Inches in a Beer-Gallon, and 231 in a Wine-Gallon, and consequently the Pint Beer-Measure to contain $35\frac{1}{4}$ solid Inches, and the Pint Wine-Measure to contain $28\frac{7}{8}$ cubical or solid Inches; from whence is drawn the following Table.

The Table of Liquid Measure.

$35\frac{1}{4}$ *cubical Inch.*	make	1 *Pint Beer measure.*
$28\frac{7}{8}$ *cubical Inch.*		1 *Pint Wine measure.*
2 *Pints.*		1 *Quart.*
2 *Quarts.*		1 *Pottle.*
2 *Pottles.*		1 *Gallon.*
8 *Gallons.*		1 *Firk. of ale, soap, or herr.*
9 *Gallons.*		1 *Firkin of beer.*
10 *Gall. and a half.*		1 *Firk. of Salmon or Eels.*
2 *Firkins.*		1 *Kilderkin.*
2 *Kilderkins.*		1 *Barrel.*
42 *Gallons.*		1 *Tierce of Wine.*
63 *Gallons.*		1 *Hogshead.*
2 *Hogsheads.*		1 *Pipe or Butt.*
2 *Pipes or Butts.*		1 *Tun of Wine.*

And therefore,

Tun	*Pipes*	*Hhds.*	*Gall.*	*Pts.*
1	2	2	63	8
1	2	4	252	2016
	1	2	126	1008
		1	63	504
			1	8
				1

7. The least denominative part of dry Measure is also a pint, and this is likewise taken from *Troy-weight.* The Table of whose Division followeth.

The Table of Dry Measure.

1 *Pint*	make	1 *Pint.*
2 *Pints*	make	1 *Quart.*
2 *Quarts*	make	1 *Pottle.*
2 *Pottles*	make	1 *Gallon.*
2 *Gallons*	make	1 *Peck.*
4 *Pecks*	make	1 *Bushel.*
4 *Bushels*	make	1 *Comb.*
2 *Combs*	make	1 *Quarter.*
4 *Quarters*	make	1 *Chaldron.*
5 *Quarters*	make	1 *Wey.*
2 *Weys*	make	1 *Last.*

An

And therefore,

last	*wey*	*qrs.*	*com.*	*bush.*	*peck*	*gall.*	*pints*
1	2	5	2	4	4	2	8
1	2	10	20	80	320	640	5120
	1	5	10	40	160	320	2560
		1	2	8	32	64	512
			1	4	16	32	256
				1	4	8	64
					1	2	16
						1	8

8. The least denominative part of *Long Measure* is a Barley-Corn well dried, and taken out of the middle of the Ear; whose Table of Parts followeth.

The Table of Long Measure.

3 *Barly corns*	make	1 *Inch.*
12 *Inches*	make	1 *Foot.*
3 *Feet*	make	1 *Yard.*
3 *Feet 9 inches or Yard and quarter*	make	1 *Ell English.*
6 *Feet*	make	1 *Fathom.*
5 *Yards and an half*	make	1 *Pole or perch*
40 *Poles or perches*	make	1 *Furlong.*
8 *Furlongs*	make	1 *English Mile.*

And therefore,

mile	*furl.*	*poles*	*yards*	*feet*	*inches*	*barl.corn*
1	8	40	$5\frac{1}{2}$	3	12	3
1	8	320	1760	5280	63360	190080
	1	40	220	660	7920	23760
		1	$5\frac{1}{2}$	$16\frac{1}{2}$	198	594
			1	3	36	108
				1	12	36
					1	3

And note that the Yard, as alſo the Ell, is uſually divided into 4 Quarters, and each Quarter into 4 Nails.

Note alſo, that a Geometrical Pace is 5 Feet; and there are 1056 ſuch Paces in an *Engliſh* Mile.

9. The parts of the Superficial Meaſures of Land are ſuch as are mentioned in the following Table, *viz.*

The Table of Land Meaſure.

40 *Square Poles or Perches*	make	1 *Rood, or quarter of an Acre.*
4 *Roods.*	make	1 *Acre.*

By the foregoing Table of long Meaſure, you are informed what a Pole, or (which is all one) Perch is; and by this that 40 ſquare Perches are 1 Rood. Now a ſquare Perch is

is a Superficies, very aptly resembled by a square Trencher, every side thereof being a Perch, or 5 Yards and a half in length, 40 of them is a Rood, and 4 Roods an Acre. So that a Superficies that is 40 Perches long and 4 broad, is an Acre of Land, the Acre containing in all 160 square Perches.

10. The least denominative Part of Time is a Minute, the greatest Integer being a Year; from whence is produced this following Table.

The Table of Time.

1 *Minute*	make	1 *Minute.*
60 *Minutes*	make	1 *Hour.*
24 *Hours*	make	1 *Day natural.*
7 *Days*	make	1 *Week.*
4 *Weeks*	make	1 *Month.*
13 *Months* 1 *day and* 6 *hours*	make	1 *Year.*

But the Year is usually divided into 12 unequal Kalendar Months, whose names and the number of Days that they contain, follow, *viz.*

	days
January	31
February	28
March	31
April	30
May	31
June	30
July	31
August	31
September	30
October	31
November	30
December	31

So that the Year containeth 365 Days, and 6 Hours; but the 6 Hours is not reckoned but only every 4th Year, and then there is a Day added to the latter end of *February*, and then it containeth 29 Days, and that Year is called Leap-year, and containeth 366 Days.

And here note, that as the Hour is divided into 60 Minutes, so each Minute is subdivided into 60 *Seconds*, and each *Second* into 60 *Thirds*, and each *Third* into 60 *Fourths*, &c.

The Tropical Year by the exactest observations of the most accurate Astronomers is found to be 365 Days, 5 hours, 49 Minutes, 4 *Seconds*, and 21 *Thirds*.

CHAP.

CHAP. III.

Of the Species or Kinds of Arithmetick.

1. ARithmetick is either Natural, Artificial, Analytical, Algebraical, Lineal or Instrumental.

2. Natural Arithmetick is that which is performed by the Numbers themselves; and this is either Positive or Negative. Positive which is wrought by certain infallible Numbers compounded, and this is either Single or Comparative; Single, which considereth the nature of *Numbers* simply by themselves; and Comparative which is wrought by *Numbers* as they have relation one to another. And the Negative part relates to the Rule of *False*.

3. Artificial (by some called Logarithmetical) Arithmetick is that which is performed by Artificial or Borrowed *Numbers*, invented for that purpose, and are called Logarithms.

4. Analytical Arithmetick, is that which ſhews from a thing unknown, to find truly that which is ſought; always keeping the Species without Change.

5. Algebraical Arithmetick, is an obſcure and hidden Art of accompting by numbers in reſolving of hard Queſtions.

6. Lineal Arithmetick, is that which is performed by Lines fitted to Proportions, as alſo Geometrical Projections.

7. Inſtrumental Arithmetick, is that which is performed by Inſtruments fitted with Circular and Right Lines of Proportions, by the motion of an Index, or otherwiſe.

8. The Parts of ſingle Arithmetick are Numeration, and the Extraction of Roots.

9. Numeration is that which by certain known numbers propounded, we diſcover another number unknown.

10. Numeration hath four Species; *viz.* Addition, Subſtraction, Multiplication, and Diviſion.

CHAP.

CHAP. IV.

Of Addition of whole Numbers.

1. ADdition is the Reduction of two, or more *Numbers* of like kind together into one summ or Total. Or, it is that by which divers *Numbers* are added together, to the end that the Summ or Total value of them all may be discovered.

The first *Number* in every Addition is called the Addible *Number*, the other, the *Number* or *Numbers* added, and the *Number* invented by the *Addition* is called the *Aggregate* or *Summ*, containing the value of the *Addition*.

The Collation of the *Numbers*, is the right placing of the *Numbers* given respectively to each denomination; and the Operation is the artificial adding of the *Numbers* given together, in order to the finding out of the *Aggregate* or Summ.

2. In Addition, place the *Numbers* given respectively the one above the other, in such sort, that the like degree, place, or denomination may stand in the same Series, *viz.* Units under Units, Tens under Tens, Hundreds under Hundreds, *&c.* Pounds under Pounds, Shillings under Shillings, Pence under Pence, *&c.* Yards under Yards Feet under Feet, *&c.*

3. Having thus placed the *Numbers* given (as before) and drawn a Line under them, add them together, beginning with the lesser Denomination, *viz.* at the right hand, and so on, subscribing the sum under the line respectively; as for Example.

Let there be given 3352 and 213 and 133 to be added together, I set the Units in each partitular *Number* under each other, and so likewise the Tens under the Tens, *&c.* and draw a Line under them as in the Margent; then I begin at the place of Units, and add them together upwards, saying, 3 and 3 are 6, and 2 make 8; which I set under the Line, and under the same Figures added together: then I proceed to the next place, being the place of Tens, and add them up in the same manner as I did the place of Units, saying, 3 and 1 are 4, and 5 are 9; which I likewise set

3352
213
133
——

ſet under the Line reſpectively; then I go to the place of Hundreds, and add them up as I did the other, ſaying, 1 and 2 are 3, and 3 are 6, which I alſo ſet under the Line; and laſtly I go to the place of Thouſands, and becauſe there are no other Figures to add to the 3, I ſet it under the Line in its reſpective place, and ſo the work is finiſhed; and I find the ſumm of the 3 given Numbers to be 3698.

4. But if the ſumm of the Figures of any Series exceeds ten, or any *Number* of tens, ſubſcribe under the ſame the Exceſs above the tens, and for every ten carry one to be added to the next Series towards the left hand, and ſo go on until you have finiſhed your Addition, always remembring, that how great ſoever the ſum of the Figures of the laſt Series is, it muſt all be ſet down under the Line reſpectively. So 3678 being given to be added to 2357, I ſet them down as is before directed, and as you ſee in the Margent with a Line drawn under them; then I begin and add them together, ſaying, 7 and 8 are 15, which is 5 above ten; wherefore I ſet 5 under the Line, and carry 1 for the ten to be added to the next Series, ſaying, 1 that I carried and 5 is 6, and 7 are 13, wherefore I ſet down 3 and carry 1 (for the ten) to the next Series,

3678
2357
6035

Series; then I say, 1 that I carried and 3 are 4, and 6 are ten; now because it comes to just 10 and no more, I set 0 under the Line, and carry 1 for the ten to the next, and say, 1 that I carried and 2 are 3, and 3 are 6, which I set down in its Respective place; thus the Addition is ended, and the total summ of these *Numbers* is found to be 6035. Several Examples of this kind follow.

Numbers to be added.	354869
	573846
	785946
	347205
Summ	2061864

Numbers to be added.	748647
	465834
	76483
	648300
Summ	1939264

Numbers to be added.	45346
	38074
	8437
	923
	76
Summ	92856

5. If the Numbers given to be added are contained under divers denominations, as of Pounds, Shillings, Pence and Farthings; or of Tuns, Hundreds, Quarters, Pounds, *&c.* Then in this case having disposed of the *Numbers*, each Denomination under o-

ther

ther of like kind; begin at the leaſt denomination, (minding how many of one denomination do make an Integer in the next,) and having added them up, for every Integer of the next greater denomination that you find therein contained, bear an unit in mind to be added to the ſaid next greater denomination, expreſſing the exceſs reſpectively under the Line, proceed in this manner until your Addition be finiſhed; the following Examples will make the Rule plain to the learner. Thus theſe ſeveral ſumms being given to be added, *viz.* 136*l.* 13*s.* 4*d.* 2*qrs.* and 79*l.* 07*s.* 10*d.* 3*qrs.* and 33*l.* 18*s* 09*d.* 1 *qrs.* alſo 15*l.* 9*s.* 5*d.* 0*qrs.* The *Numbers* being diſpoſed according to order will ſtand as in the Margent. Then I begin at the denomination of Farthings, and add them up, ſaying 1 and 3 are 4 and 2 make 6; now I conſider that 6 Farthings is 1 Penny and 2 Farthings, wherefore I ſet down the 2 Farthings in its place under the Line, and keep 1 in mind to be added to the next denomination of pence; then I go on, ſaying, 1 that I caried and 5 are 6, and 9 are 15, and 10 are 25, and 4 are 29; now I conſider that 29 pence are 2 ſhillings and 5 pence, wherefore I ſet the

l.	s.	d,	qrs.
136	13	04	2
79	07	10	3
33	18	09	1
15	09	05	0
265	09	05	2

the 5 pence in order under the Line, and keep 2 in mind for the shillings, to be added to the shillings; then I go on, saying, 2 that I carried and 9 are 11, and 18 are 29, and 7 are 36, and 13 are 49; then I consider that 49 shillings are 2 pounds and 9 shillings, wherefore I set the 9 shillings under the Line, and carry 2 for the two pounds, to the next and last denomination of pounds, and proceed, saying, 2 that I carried and 5 make 7, and 3 are 10, and 9 are 19, and 6 are 25; I then set down 5 and carry 2 for the 2 tens, and proceed, saying, 2 that I carry and 1 is 3, and 3 are 6, and 7 are 13, and 3 make 16; I set down 6, and carry 1 for the ten, and go on, saying, 1 that I carried and 1 are 2, which I set in its place under the Line, and the work is finished; and thus I find the summ of the foresaid *Numbers* to be 265*l.* 09 *s.* 05 *d.* 02 *qrs.* This to the ingenious Practitioner is sufficient; but I shall (for the farther illuminating of weaker apprehensions) explain the operation of another Example in *Troy weight*; and here the Learner must take notice of the Table of *Troy weight* mentioned, or set down in the third Section of the second Chapter. The *Numbers* given in this Example, are 38 *l.* 7 *oz.* 13 *p.w.* 18 *gr.* And 50 *l.* 10 *oz.* 10 *p.w.* 12 *gr.* And 42 *l.* 08 *oz.* 05 *p.w.* 16 *gr.* And

in

in order to the Addition thereof, I place them as you ſee, and proceed to operation; ſaying, 16 and 12 are 28, and 18 are 46; now becauſe 24 *grains* make 1 *penny weight*, 46 *grains* are 1 *penny weight* and 22 *grains*; wherefore I ſet down 22, and carry 1 for the *penny weight*, and going on, I ſay, 1 that I carry and 5 make 6, and 10 are 16, and 13 are 29, which is 1 ounce and 9 *penny weight*; I ſet down 9 in its place under the Line, and carry 1 to the ounces, ſaying, 1 that I carry and 8 are 9, and 10 are 19, and 7 are 26, and becauſe 26 *ounces* make 2 *pound* 2 *ounces*, I ſet down 2 for the *ounces*, and carry 2 to the *pounds*, going on; 2 that I carry and 2 are 4, and 8 make 12, that is 2 and go 1; then 1 I carry and 4 are 5, and 5 are 10, and 3 are 13, which I ſet down as in the Margent, and the work is finiſhed, and I find the ſumm of the ſaid *Numbers* to amount to 132 *l.* 02 *oz.* 09 *p.w.* 22 *gr.* This is ſufficient for the underſtanding of the following Examples, or any other that ſhall come to thy View. The Way of proving theſe or any ſumms in this Rule is ſhewed immediately after the enſuing Examples.

l.	*oz.*	*p.w.*	*gr.*
28	07	13	18
56	10	10	12
42	08	05	16
132	02	09	22

Addition

Addition of English Money.

l.	s.	d.	qrs.	l.	s.	d.	qrs.
436	13	07	1	48	15	11	1
184	09	10	3	76	10	07	3
768	17	04	2	18	00	05	3
564	11	11	0	24	19	09	2
1954	12	09	2	168	06	10	1

Addition of Troy-Weight.

l.	oun.	p.w.	gr.	l.	oun.	p.w.	gr.
15	07	13	12	145	09	12	18
18	06	04	20	726	08	14	10
11	10	16	18	380	07	06	13
09	04	10	22	83	10	16	20
19	11	18	04	130	00	10	12
22	00	00	00	71	07	15	00
97	05	04	04	1541	08	16	01

Addition of Apothecaries Weights.

l.	oun.	dr.	scr.	gr.	l.	oun.	dr.	scr.	gr.
48	07	1	0	14	60	03	4	0	10
74	05	5	2	10	48	10	6	0	14
64	10	7	1	16	34	08	2	1	15
17	08	1	0	11	18	11	2	2	11
34	09	6	1	09	160	07	1	2	15
					35	02	5	1	07
240	05	6	1	00	358	07	7	0	12

Addition

Addition of Averdupois Weight.

Tun	C.	qrs.	l.	l.	oun.	dr.
75	13	1	15	36	10	12
48	07	3	21	22	11	13
60	11	1	17	11	07	04
21	07	0	25	15	04	10
22	16	0	11	20	00	09
18	16	0	05	106	03	00

Addition of Liquid Measure.

Tun	pipe	hhd.	gall.	Tun	hhds.	gall.	pts.
45	1	1	48	30	3	40	4
15	0	1	17	12	0	28	6
38	0	0	47	47	5	60	5
12	1	0	56	57	3	22	3
21	1	1	18	17	0	00	0
33	1	1	60	166	1	26	2

Addition of Dry Measure.

Chald.	qrs.	bush.	pec	qrs.	bush.	pec.	gall.
48	3	7	3	17	3	1	1
13	1	4	0	50	1	3	0
54	0	6	2	14	5	3	1
16	3	6	1	40	2	0	1
40	1	0	1	30	0	3	0
173	3	3	0	152	5	3	1

Addition

Addition of Long Measure.

Yds.	Qrs.	Na.	Ells.	Qrs.	Na.
35	3	3	56	1	3
14	1	2	13	3	2
74	2	3	48	2	1
38	0	1	50	1	0
30	1	0	73	0	2
15	0	0	17	1	0
218	1	1	260	2	0

Addition of Long Measure.

Acre	Rood	Per.	Acre	Rood	Per.
12	3	18	86	1	36
14	0	24	47	3	24
30	2	19	73	2	18
48	3	30	60	0	07
28	1	38	04	2	c8
50	3	26	14	1	14
185	3	35	286	3	27

The Proof of Addition.

6. *Addition* is proved after this manner; when you have found out the summ of the *Numbers* given, then separate the uppermost Line from the rest, with a stroke or dash of the pen, and then add them all up again as yo

ou did before, leaving out the uppermoſt Line; and having ſo done, add this new inented ſumm to the uppermoſt Line you ſeparated, and if the ſumm of thoſe two Lines e equal to the ſumm firſt found out, then the work was performed true, otherwiſe not; s for Example: let us prove the firſt example of *Addition* of Money, whoſe ſumm we ound to be 265 *l.* 9 *s.* 5 *d.* 2 *qrs.* and which we prove thus: Having ſeparated the uppermoſt number from the reſt, by a Line, as you ſee in the margent, then I add the ſame together again, leaving out the ſaid uppermoſt Line, and the ſum thereof I ſet under the firſt ſumm or true ſumm, which doth amount to 128 *l.* 16 *s.* 01 *d.* 0 *qrs.* then again I add this new ſumm to the uppermoſt Line that before was ſeparated from the reſt, and the ſumm of theſe two is 265 *l.* 09 *s.* 05 *d.* 2 *qrs.* the ſame with the firſt ſumm, and therefore I conclude that the Operation was rightly performed.

l.	*s.*	*d.*	*qrs.*
136	13	04	2
79	07	10	3
33	10	09	1
15	09	05	0
265	09	05	2
128	16	01	0
265	09	05	2

7. The

7. The main end of *Addition* in Questions resolvable thereby, is to know the summ of several Debts, Parcels, Integers, *&c.* some Questions may be these that follow,

Quest. 1. There was an old Man whose age was required, to which he replied, I have seven Sons, each having two years between the birth of the other, and in the 44 year of my age my eldest Son was born, which is now the Age of my youngest; I demand what was the old man's age?

Now to resolve this Question, first set down the Father's age at the birth of his first Child, which was 44, then the difference between the eldest and the youngest, which is 12 years, and then the age of the youngest which is 44, and then add them all together, and their summ is 100, the compleat age of the Father.

$$\begin{array}{r} 44 \\ 12 \\ 44 \\ \hline 100 \end{array}$$

Quest. 2. A man lent his Friend, at several times, these several summs, (*viz.*) at one time 63 *l.* at another time 50 *l.* at another time 48 *l.* at another time 156 *l.* now I desire to know how much was lent him in all.

Set the ſumms lent one under nother, as you ſee in the Margent, nd then add them together, and you vill find their ſumm to amount to 317 *l.* which is the Total of all the everal ſumms lent, and ſo much is ue to the Creditor.

l.
63
50
48
156
———
317

Queſt. 3. From *London* to *Ware* is 20 niles, thence to *Huntington* 29 miles, thence o *Stamford* 21 miles, thence to *Tuxford* 36 niles, thence to *Wentbridge* 25 miles, from hence to *York* 20 miles. Now I deſire to now how many miles it is from *London* to *ork*, according to this Reckoning?

Now to anſwer this Queſtion, et down the ſeveral diſtances iven, as you ſee in the Margent, nd add them together, and you vill find their ſumm to amount to 51, which is the true diſtance n miles between *London* and *ork.*

20
29
21
36
25
20
———
151

Queſt. 4. There are 2 Numbers, the leaſt vhereof is 40, and their difference is 14, deſire to know what is the greater Num-er, and alſo what is the ſumm of them both?

Firſt

First set down the least, *viz.* 40, and 14 the difference, and add them together, and their sum is 54 for the greatest Number; then I set 40 (the least) under 54 (the greatest) and add them together, and their summ is 94, equal to the greatest and least Numbers.

	40
	14
greatest	54
least	40
summ	94

CHAP. V.

Of Substraction of whole Numbers.

1. SUbstraction is the taking of a lesser Number out of a greater of like kind, whereby to find out a third Number, being or declaring the inequality, excess, or difference between the Numbers given: Or *Substraction* is that by which one Number is taken out of another Number given, to the

en

end that the residue, or remainder may be known, which remainder is also called the *Rest*, *Remainder*, or *Difference* of the Numbers given.

2. The Number out of which *Substraction* is to be made, must be greater, or at least equal with the other Number given, the higher or superior Number is called the major Number, and the lower or inferior is called the minor Number, and the Operation of *Substraction* being finished, the rest or remainder is called the Difference of the Numbers given.

3. In *Substraction* place the Numbers given respectively the one under the other, in such sort, as like Degrees, Places, or Denominations may stand in the same Series, *viz.* Units under Units, Tens under Tens, *&c.* Pounds under Pounds, *&c.* Feet under Feet, and Parts under Parts, *&c.* This being done, draw a Line underneath, as in *Addition.*

4. Having placed the *Numbers* given as is before directed, and drawn a Line under them, substract the lower Number (which in this case must always be lesser than the uppermost) out of the higher *Number*, and subscribe the difference, or remainder, respectively below the Line; and when the Work is finished, the Number below the line

line will give you the Remainder; as for Example: Let 364521 be given to be Substracted from 795836; I set the lesser under the greater as in the margent, and draw a line under them; then beginning at the Right hand, I say, 1 out of 6 and there remains 5, which I set in order under the line; then I proceed to the next, saying, 2 from 3, rests 1, which I note also under the line; and thus I go on until I have finished the Work, and then I find the Remainder or Difference to be 441315.

795836
364521
431315

5. But if it so happen (as commonly it doth) that the lowermost *number* or figure is greater than the uppermost; then in this case add ten to the uppermost *number*, and Substract the said lowermost *number* from their Summ, and the remainder place under the line, and when you go to the next figure below, pay an unit by adding it thereto for the 10 you borrowed before, and substract that from the higher *Number* or Figure: And thus go on, until your Substraction be finished; as for Example: Let 437503 be given, from whence it is required to substract 153827, I dispose of the *numbers* as is before directed, and as you see in the margent; then I begin, saying, 7 from 3 I

can-

cannot, (but adding 10 thereto, I say,) 7 from 13 and there remains 6 which I set under the Line in order; then I proceed to the next figure, saying, 1 that I borrowed and 2 is 3, from 0 I cannot, but 3 from 10 and there remains 7, which I likewise set down as before; then 1 that I borrowed and 8 is 9, from 5 I cannot, but 9 from 15 and there remains 6; then 1 I borrowed and 3 is 4, from 7 and there remains 3; then 5 from 3 I cannot, but 5 from 13 and there remains 8; then 1 I borrowed and 1 is 2, from 4 and there rest 2; and thus the Work is finished: And after these *Numbers* are *Substracted* one from another, the Inequality, Remainder, Excess, or Difference is found to be 283676.

	437503
	153827
	283676

Examples for thy farther Experience may be these that follow.

From	3475016	*From*	3615746
Take	738642	*Take*	5864
Rests	2736374	*Rests*	3609882

6. If the *Summs* or *Numbers* to be *Substracted*, are of several denominations,

 place

place the lesser *summ* below the greater, and in the same Rank and order as is shewed in Addition of the same *Numbers*; then begin at the Right hand, and take the lower *Number* out of the uppermost, if it be lesser; but if it be bigger than the uppermost, then borrow an Unit from the next greater denomination, and turn it into the parts of the lesser denomination, and add those parts to the uppermost *Number*, and from their *summ* substract the lowermost, noting the remainder below the Line; then proceed, and pay 1 to the next denomination for that which you borrowed before, and proceed in this order untill the Work be finished. An Example of this Rule may be this that followeth, let 375 *l.* 13 *s.* 07 *d.* 1 *qrs.* be given, from whence let it be required to *Substract* 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* In order whereunto I place the *Numbers* as you see in the Margent, and thus I begin at the least denomination, saying,

l.	*s.*	*d.*	*qrs.*
375	13	07	1
57	16	03	2
317	17	03	3

two from one I cannot, therefore I borrow one penny from the next denomination, and turn it into Farthings which is four, and adding four to one, which is five, I say, but two from five and there remains three, which I put under the

the line; then going on, I say, one that I borrowed and three is four, from seven and there rests three; then going on, I say, sixteen from thirteen I cannot, but (borrowing one pound, and turning it into twenty shillings, I add it to thirteen, and that is thirty three, wherefore I say) sixteen from thirty three, and there remains seventeen, which I set under the Line, and go on, saying, one that I borrowed, and seven is eight, from five I cannot, but eight from fifteen, and there remains seven; the one that I borrowed and five is six, from seven there rests one, and nothing from three rest three, and the work is done; and I find the remainder or difference to be 317 *l*, 17 *s*. 03 *d*. 3 *qrs*.

Another Example of *Troy Weight* may be this, I would *Substract* 17 *l*. 10 *oz*. 11 *p.w*. 20 *gr*. from 24 *l*. 05 *oz*. 00 *p.w*. 08 *gr*. I place the *Numbers* according to the Rule, and begin, saying, twenty from eight I cannot, but borrow one penny *Weight*, which is twenty four *Grains*, and add them to eight and they are thirty two, wherefore I say twenty from thirty two rest twelve; then one that I borrowed and eleven is twelve, from 00 I cannot, but twelve from twenty (bor-

l.	*oz.*	*p.w.*	*gr.*
24	05	00	08
17	10	11	20
06	06	08	12

rowing an Ounce which is twenty Penny Weight) and there remain 8; then 1 that I borrowed and 10 is 11, from 5 I cannot, but 11 from 17 and there reſt 6; then 1 that I borrowed and 7 is 8, from 4 I cannot, but 8 from 14 and there reſt 6; then 1 that I borrowed and 1 is 2, from 2 and there reſts nothing; ſo that I find the Remainder or Difference to be 6 *l.* 6. *oz.* 8 *p.w.* 12 *gr.*

7. It many times happeneth that you have many Summs or Numbers to be ſubſtracted from one Number; as ſuppoſe a Man ſhould lend his Friend a certain ſumm of Money, and his Friend had paid him part of his Debt at ſeveral times, then before you can conveniently know what is ſtill owing, you are to add the ſeveral Numbers or Summs of Payment together, and ſubſtract their ſumm from the whole Debt, and the Remainder is the ſumm due to the Creditor; as ſuppoſe A lendeth to B 564 *l.* 18 *s.* 10 *d.* and B hath repaid him 79 *l.* 16 *s.* 08 *d.* at one time, and 163 *l.* 18 *s.* 11 *d.* at another time, and 241 *l.* 15 *s.* 08 *d.* at another time; and you would know how the Accompt ſtandeth between them, or what more is due to A. In order whereunto, I firſt ſet down the ſumm which A lent, and draw a Line underneath it, then under

that

that Line ſet ſeveral ſumms of payment as you ſee in the Margent, and having brought the ſeveral ſumms of payment into one Total by the 5*th*. Rule of the 4*th*. Chapter foregoing, I find their ſumms amounteth to 485*l*. 11*s*. 3*d*. which I ſubſtract from the ſumm firſt lent by A, by the 6*th*. Rule of this Chapter, and I find the Remainder to be 79 *l*. 02 *s*. 07 *d*. And ſo much is ſtill due to A.

	l.	s.	d.
Lent	564	13	10
Paid at ſeveral payments.	79	16	08
	163	18	11
	241	15	08
paid in all	485	11	03
Remains	79	02	07

When the Learner hath good knowledge of what hath been already delivered in this and the foregoing Chapter, he will with eaſe underſtand the manner of working the following Examples.

Substraction of whole Money.

	l.	s.	d.	l.	s.	d.	qrs.
Borrowed	374	10	03	700	10	11	2
Paid	79	15	11	9	03	11	3
Remains	304	14	04	691	06	11	3

	l.	s.	d.	l.	s.	d.	qrs.
Borrowed	1000	00	00	711	03	00	0
Paid	19	00	06	11	13	00	1
Rem. due	980	19	06	699	09	11	3

	l.	s.	d.	qrs.
Borrowed	3300	00	00	0
Paid at several Payments.	170	10	00	0
	361	13	10	1
	590	03	04	3
	73	04	11	3
Paid in all	1195	12	02	3
Remain due	2104	07	09	1

Substraction of Troy Weight.

	l.	oz.	p.w.	gr.
Bought	174	00	13	00
Sold	78	04	16	15
Remains	95	07	16	09

Bought

	l.	oz.	p.w.	gr.
Bought	470	10	13	00
Sold at several times.	60	00	00	00
	35	10	18	00
	16	07	09	08
	48	04	00	00
	61	11	19	23
	23	00	00	00
Sold in all	245	10	07	07
Rem. unsold	225	00	05	17

Substraction of Apothecaries Weights.

	l.	oz.	dr.	scr.	gr.	l.	oz.	dr.	scr.	gr
Bought	12	04	3	0	00	20	00	1	0	07
Sold	8	05	1	1	15	10	00	1	2	12
Remains	3	11	1	1	05	9	11	7	0	15

Substraction of Averdupois Weight.

	C.	qrs.	l	Tun	C.	qrs.	l.	oz.	dr.
Bought	35	0	15	5	07	1	10	10	05
Sold	16	2	20	3	17	1	16	09	13
	18	2	23	1	09	3	22	00	08

Substraction of Liquid Measure.

	Tun	hhd	gall.	Tun	hhd	gall	pts.
Bought	40	1	30	60	3	42	4
Sold	16	1	40	15	3	46	6
Remains	23	3	53	44	3	58	6

Substraction of Dry Measure.

	Chal.	qrs.	bush.	pec.	Ch.	qrs.	bush.	pec.
Bought	100	0	00	0	73	2	3	2
Sold	54	1	04	3	46	2	3	2
Remains	45	2	03	1	26	3	7	3

Substraction of Long Measure.

	yards	qrs.	nails	yards	qrs.	nails
Bought	160	1	0	344	0	1
Sold	64	1	2	177	1	3
Remains	95	3	2	166	2	2

Substraction of Land Measure.

	Acres	Rood	Perch.	Acres	Rood	Per.
Bought	140	2	13	600	0	00
Sold	70	3	12	54	0	16
Remains	69	2	31	545	3	34

The

The Proof of Subſtraction.

8. When your Subſtraction is ended, if you deſire to prove your Work, whether it be true or no; then add the remainder to the minor Number, and if the Aggregate of theſe two be equal to the major *Number*, then is your Operation true, otherwiſe falſe; thus let us prove the firſt Example of the fifth Rule of this Chapter, where after Subſtraction is ended, the Numbers ſtand as in the Margent; the remainder or difference being 283676;

437503
153827
283676

now to prove the Work, I add the ſaid remainder 283676 to the minor Number 153827, by the fourth Rule of the foregoing Chapter, and I find the Summ or Aggregate to be 437503, equal to the major Number, or Number from whence the leſſer is ſubſtracted: Behold the Work in the Margent.

437503
153827
283676
437503

The proof of another *Example*, may be of the firſt Example of the ſixth Rule of this Chapter, where it is required to ſubſtract 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* from 375 *l.* 13 *s.* 07 *d.* 1 *qrs.* and by the Rule I find the remainder to be 317 *l.* 17 *s.* 03 *d.* 3 *qrs.* now to prove it, I add the ſaid re-

mainder 317 *l.* 17 *s.* 03 *d.* 3 *qrs.* to the minor *Number*, 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* and their ſumm is 375 *l.* 13 *s.* 07 *d.* 1 *qrs.* equal to the major *Number*, which proves the Work to be true ; but if it had happened to have been either more or leſs than the ſaid major *Number*, then the *Operation* had been falſe.

l.	*s.*	*d.*	*qrs.*
375	13	07	1
57	16	03	2
317	17	03	3
375	13	07	1

9. The general effect of *Subſtraction* is to find the difference or exceſs between two *Numbers*, and the *Reſt* when a payment is made in part of a greater ſumm, the date of Books printed, the age of any thing by knowing the preſent year, and the year wherein they were made, created or built, and ſuch like.

The Queſtions appropriated to this *Rule* are ſuch as follow.

Queſt. 1. What difference is there between one thing of 125 Foot long, and another of 66 Foot long?

To reſolve this Queſtion, I firſt ſet down the major or greater *Number* 125, and under it the minor or leſſer *Number* 66, as is directed in the third *Rule* of this *Chapter*, and according to the fourth Rule of

125
66
59

of the ſame I *Subſtract* the Minor from the Major, and the Remainder, Exceſs, or Difference I find to be 59; ſee the Work in the Margent.

Queſt. 2. A Gentleman oweth a *Merchant* 365*l.* whereof he hath paid 278 *l.* what more doth he owe?

To give an *Anſwer* to this *Queſtion*, I firſt ſet down the *major number*, 365*l.* and under it place 278 the *minor*, and *ſubſtract* the one from the other, and thereby I diſcover the Exceſs, Difference, or Remainder to be 87, and ſo much is ſtill due to the *Creditor*. As *per Margent.*

365
278
87

Queſt. 3. An obligation was written, a Book Printed, a Child Born, a Church Built, or any other thing made, in the Year of our Lory 1572, and now we account the Year of our Lord 1687, the *Queſtion* is to know the age of the ſaid things, that is, how many Years are paſſed ſince the ſaid things were made; I ſay if you *ſubſtract* the leſſer *Number* 1572, from the greater 1687, the Remainder will be 115, and ſo many Years are paſt ſince the making of the ſaid things as by the Work in the Margent.

1687
1572
115

Queſt. 4. There are three Towns lie in a ſtreight Line (*viz.*) *London*, *Huntington*, and

and *York*, now the Diſtance between the fartheſt of theſe Towns, *viz.* *London* and *York* is 151 miles, and from *London* to *Huntington* is 49 miles, I demand how far it is from *Huntington* to *York*.

To reſolve this *Queſtion*, *Subſtract* 49, the diſtance between *London* and *Huntington*, from 151, the diſtance between *London* and *York*, and the Remainder is 102, for the true Diſtance between *Huntington* and *York*. See the Work in the Margent.

151
49
———
102

CHAP. VI.

Of Multiplication of whole Numbers.

1. MUltiplication is performed by two *Numbers* of like kind, for the *Production* of a third, which ſhall have ſuch reaſon to the one, as the other hath to Unit, and in effect is moſt brief and artificial compound *Addition* of many equal *numbers* of like kind into one ſumm. Or, *Multiplication* is that by which we *multiply* two or

or more *Numbers*, the one into the other, to the end that their Product may come forth, or be discovered.

Or, *Multiplication* is the increasing of any one *Number* by another, so often as there are Units in that *Number*, by which the other is increased; or by having two *Numbers* given to find a third, which shall contain one of the *Numbers* as many times as there are Units in the other.

2. *Multiplication* hath three parts. First the *Multiplicand*, or *Number* to be *multiplied*. Secondly, the *Multiplier*, or *Number* given, by which the *Multiplicand* is to be *multiplied*. And, Thirdly, the *Product* or *Number* produced by the other two, the one being *multiplied* by the other; as, if 8 were given to be *multiplied* by 4, I say, 4 times 8 is 32; here 8 is the *Multiplicand*, and 4 is the *Multiplier*, and 32 is the Product.

$$\begin{array}{r} 8 \\ \underline{4} \\ 32 \end{array}$$

3. *Multiplication* is either single by one figure, or compound, that consists of many.

Single *Multiplication* is said to consist of one figure, because the *Multiplicand* and *Multiplier* consist each of them of a Digit, and no more, so that the greatest Product that can arise by single *Multiplication* is 81, being

being the ſquare of 9; and Compound *Multiplication* is ſaid to conſiſt of many figures, becauſe the *Multiplicand*, or *Multiplier*, conſiſt of more places than one; as if I were to *multiply* 436 by 6, it is called compound, becauſe the *Multiplicand* 436 is of more places than one, (*viz.*) 3 places.

4. The Learner ought to have all the varieties of ſingle *Multiplication* by heart, before he can well proceed any farther in this Art, it being of moſt excellent Uſe, and none of the following Rules in *Arithmetick* but what have their principal dependance thereupon, which may be learnt by the following Table.

Multiplication Table.

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

The uſe of the precedent Table is this, in the uppermoſt Line or Column you have expreſſed all the Digits from 1 to 9, and likewiſe beginning at 1 and going downwards in the ſide Column you have the ſame; ſo that if you would know the Product of any two ſingle *Numbers* multiplied by one another, look for one of them (which you pleaſe) in the uppermoſt Column, and for the other in the ſide Column, and running your eye from each Figure along the reſpective Colums, in the common *Angle* (or Place) where theſe two Columns meet, there is the Product required. As for Example, I would know how much is 8 times 7: Firſt, I look for 8 in the uppermoſt Column, and 7 in the ſide Column; then do I caſt my eye from 8 along the Column downwards from the ſame, and likewiſe from 7 in the ſide Column, I caſt my eye from thence towards the right hand, and find it to meet with the firſt Column at 56, ſo that I conclude 56 to be the Product required; it would have been the ſame if you had looked for 7 in the top, and 8 on the ſide; the like is to be underſtood of any other ſuch *Numbers*. The Learner being perfect herein, it will be neceſſary to proceed.

5. In Compound *Multiplication*, if the

Multi-

being the ſquare of 9; and Compound *Multiplication* is ſaid to conſiſt of many figures, becauſe the *Multiplicand*, or *Multiplier*, conſiſt of more places than one; as if I were to *multiply* 436 by 6, it is called compound, becauſe the *Multiplicand* 436 is of more places than one, (*viz.*) 3 places.

4. The Learner ought to have all the varieties of ſingle *Multiplication* by heart, before he can well proceed any farther in this Art, it being of moſt excellent Uſe, and none of the following Rules in *Arithmetick* but what have their principal dependance thereupon, which may be learnt by the following Table.

Multiplication Table.

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

The uſe of the precedent Table is this, in the uppermoſt Line or Column you have expreſſed all the Digits from 1 to 9, and likewiſe beginning at 1 and going downwards in the ſide Column you have the ſame; ſo that if you would know the Product of any two ſingle *Numbers* multiplied by one another, look for one of them (which you pleaſe) in the uppermoſt Column, and for the other in the ſide Column, and running your eye from each Figure along the reſpective Colums, in the common *Angle* (or Place) where theſe two Columns meet, there is the Product required. As for Example, I would know how much is 8 times 7: Firſt, I look for 8 in the uppermoſt Column, and 7 in the ſide Column; then do I caſt my eye from 8 along the Column downwards from the ſame, and likewiſe from 7 in the ſide Column, I caſt my eye from thence towards the right hand, and find it to meet with the firſt Column at 56, ſo that I conclude 56 to be the Product required; it would have been the ſame if you had looked for 7 in the top, and 8 on the ſide; the like is to be underſtood of any other ſuch *Numbers*. The Learner being perfect herein, it will be neceſſary to proceed.

5. In Compound *Multiplication*, if the

Multi-

Multiplicand confifts of many places, and the Multiplier of but one Figure; firft fet down the *Multiplicand*, and under it place the Multiplier in the place of Units, and draw a Line underneath them; then begin and multiply the Multiplier into every particular Figure of the Multiplicand, beginning at the place of Units, and fo proceed towards the left hand, fetting each particular Product under the Line, in order as you proceed; but if any of the Products exceed 10, or any Number of Tens, fet down the Excefs; and for every 10, carry a Unit to be added to the next Product, always remembring to fet down the Total Product of the laft Figure; which Work being finifhed, the Summ or Number placed under the Line, fhall be the true and total Product required. As for Example, I would multiply 478 by 6; firft I fet down 478, and underneath it 6 in the place of Units, and draw a Line underneath them, as in the Margent; then I begin, faying, 6 times 8 is 48, which is 8 above four Tens, therefore I fet down 8 (the Excefs) and bear 4 in mind for the four Tens; then I proceed, faying, 6 times 7 is 42, and 4 that I carried is 46; I then fet down 6, and carry 4, and go on, faying, 6 times 4 is 24, and 4 that

$$\begin{array}{r} 478 \\ 6 \\ \hline 2868 \end{array}$$

I

I carried is 28, and becauſe it is the laſt Figure, I ſet it all down, and ſo the Work is finiſhed, and the Product is found to be 2868 as was required.

6. When in Compound *Multiplication* the *Multiplier* conſiſteth of divers places, then begin with the Figure in the place of Units in the *Multiplier*, and *multiply* it into all the Figures in the *Multiplicand*, placing the Product below the Line, as was directed in the laſt Example; then begin with the Figure of the ſecond place of the *Multiplier*, (*viz.*) the place of Tens, and *multiply* it likewiſe into the whole *Multiplicand* (as you did the firſt Figure) placing its Product under the Product of the firſt Figure; do in the ſame manner by the third, fourth, and fifth, *&c.* until you have *multiplied* all the Figures of the *Multiplier* particularly into the whole *Multiplicand*, ſtill placing the Product of each particular Figure under the product of its precedent Figure; herein obſerving the following Caution.

A Caution. In the placing of the Product of each particular Figure of the *Multiplier*, you are not to follow the 2*d.* Rule of the 4*th.* Chapter, *viz.* to place Units under Units, and Tens under Tens, *&c.* but to put the Figure or

Cypher

Cypher in the place of Units of the second line under the second figure or place of Tens in the Line above it, and the Figure or Cypher in the place of units of the third line under the place of Tens in the second line, &c. Observing this order 'till you have finished the work, *viz.* still placing the first Figure of every line or product under the second Figure or place of Tens in that which was above it; and having so done, draw a line under all these particular products, and add them together; so shall the summ of all these Products be total Products required.

As if it were required to *multiply* 764 by 27, I set them down the one under the other, with a line drawn underneath them; then I begin, saying, seven times four is 28, then I set down 8 and carry 2, then say 7 times 6 is 42, and 2 that I carried is 44, that is 4 and go 4; then 7 times 7 is 49, and 4 that I carry is 53, which I set down, because I have not another Figure to *multiply*: Thus have I done with the 7, then I begin with the 2, saying, 2 times 4 is 8, which I set down under (4) the second Figure or place of Tens in the line above it, as you may see in the Margent: Then I proceed, saying, 2 times 6 is 12, that is 2 and carry one; then two times

$$\begin{array}{r} 764 \\ 27 \\ \hline 5348 \\ 1528 \\ \hline 20628 \\ \hline \end{array}$$

times ſeven is fourteen, and one that I carry is fifteen, which I ſet down becauſe 'tis the Product of the laſt Figure; ſo that the Product of 764 by 7 is 5348, and by 2 is 1528; which being placed the one under the other as before is directed, and as you ſee in the Margent, and a Line drawn under them, and they added together reſpectively, make 20628 the true Product required, being equal to 27 times 764.

Another Example may be this: Let it be required to multiply 5486 by 465, I diſpoſe of the Multiplicand and Multiplier, according to Rule, and begin multiplying the firſt Figure of the Multiplier, which is five, into the whole Multiplicand, and the Product is 27430; then I proceed and multiply the ſecond Figure (6) of the Multiplier into the Multiplicand, and find the Product to amount to 32916, which is ſubſcribed under the other Product reſpectively; then do I multiply the third and laſt Figure (4) of the Multiplier into the Multiplicand, and the Product is 21944, which is likewiſe placed under the ſecond line reſpectively; then I draw a Line under the ſaid Products (being placed the one under the other according to Rule) and add them toge-

$$\begin{array}{r} 5486 \\ 465 \\ \hline 27430 \\ 32916 \\ 21944 \\ \hline 2550990 \\ \hline \end{array}$$

together, and the ſumm is 2550990 the, true Product ſought, being equal to 5486 times 465, or 465 times 5486.

More Examples in this Rule are theſe following.

```
   430865
     4739
 --------
  3877785
 1292595
3016055
1723460
---------
2041869235
```

```
       640075
         3749
    ---------
     38404548
    57606822
   25603032
  44805306
 19202274
 ------------
 240002821968
```

Compendiums in Multiplication.

7. Although the former Rules are ſufficient for all Caſes in Multiplication; yet becauſe in the Work of Multiplication many times great labour may be ſaved, I ſhall acquaint the Learner with ſome Compendiums in order thereto, *viz.* If the Multiplicand or Multiplier, or both of them end with Cyphers; then in your multiplying, you may neglect the Cyphers, and multiply only the ſignificant Figures, and to the Product of thoſe ſignificant Figures, add ſo many Cyphers as the Numbers given to be multiplied did end with

Si e numeris propoſitis unus vel uterque adjunctos habeat ad dextram circulos; omiſſis circulis, fiat ipſorum numerorum multiplicatio, & facto demum tot inſuper integrorum loci adjungi cenſeantur, quot fuere omiſſi circuli in utroque facto e. Clavis Ma. c. 4.

that

hat is, annex them on the right hand of the aid Product; so shall that give you the true Product required: As if I were to multiply 32000 by 4300, I set hem down in order to be multiplied as you see in the Margent, but neglecting the Cyphers in both Numbers, only multiply 32 by 43, and the Product I find to be 376, to which I annex the 5 Cyphers that re in the Multiplicand and Multiplier, and hen it makes 137600000 for the true Product of 320000 by 4300.

```
    32000
     4300
 --------
   96
  128
 --------
137600000
```

8. If in the Multiplier, Cyphers are placed between significant Figures, then multiply only by the significant Figures, neglecting the Cypher, but here special notice is to be taken of the true placing of the first Figure after the neglect of such Cypher or Cyphers, and therefore you must observe in what place of the Multiplier the figure you multiply by standeth, and set the first Figure of that Product under the same place of the Product of the first Figure of your Multiplier; As for Example, et it be required to multiply 371568 by 0007, first I multiply the Multiplicand by

Si intermedio multiplicantis loco circulus fuerit, Ille negligitur. Alsted. Cap. 6. de Arithm.

by ſeven and the Product is 2600976, then neglecting the Cyphers, I multiply by 4, and that Product is 1486272 now I conſider that four is the fifth Figure in the Multiplier, therefore I place two (the firſt Figure of the Product by four) under the fifth place of the firſt Product by ſeven, and the reſt in order, and having added them together, the total Product is found to be 1486532 0976; other Examples in this Rule are theſe following.

```
      371568
       40007
    --------
     2600976
 1486272
 -----------
 14865320976
```

```
    327586
      6030
    ------
    982758
 1965516
 ---------
 1975343580
```

```
    7864371
      20604
    -------
   31457484
 47186226
15728742
-----------
16203750084
```

§ 9. If you are to multiply any Number by an Unit with Cyphers, (*viz.*) by 10, 100, 1000, *&c.* then annex ſo many Cyphers before the Multiplicand, and that Number when the Cyphers are annexed, is the Product required; as if you would multiply 428 by 100, annex two Cyphers to 428 and it is 42800: If it were required to multiply 102 by 10000, annex 4 Cyphers and

nd if gives 1020000 for the product re-uired.

The Proof of Multiplication.

10. *Multiplication* is proved by *Division*, nd to speak truth all other ways are false; nd therefore it will be most onvenient in the first place, o learn *Division*, and by that oprove *Multiplication*. There s a Way (at this day ge-generally used in Schools) to prove *Multi-lication*, which is this, first add all the igures in the *Multiplicand* together as if hey were simple *Numbers*, casting away he nines as often as it comes to so much, ndnoting the Remainder at last, which in his case cannot be so much as 9; Cast like-wise the nines out of the *Multiplier* as you id out of the *Multiplicand*, and Note that Remainder; then *Multiply* the Remainders, he one by the other, and cast the nines out f that product, observing the Remainder: And lastly, cast the nines out of the total product, and if this Remainder be equal to he Remainder last found, then they con-clude the Work to be rightly performed; ut there may be given a thousand (nay in-inite) false products in a *Multiplication*, which

Namque est quod aliam expectes ex-nullo innixæ funda-aminandi viam : nam alia vulgares & falsæ sunt, & mento. Gem. Fris.

which after this manner may be proved to be true and therefore this way of proving doth not deſerve any Example; but we ſhall defer the Proof of this Rule till we come to prove Diviſion, and then we ſhall Prove them both together.

11. The general Effect of *Multiplication* is contained in the definition of the ſame, which is to find out a 3*d.* *Number*, ſo often containing one of the two given *Numbers* as the other containeth Unit.

The ſecond Effect is by having the length and breadth of any thing (as a Parallelogram, or long plain) to find the ſuperficial Content of the ſame, and by having the ſuperficial Content of the Baſe and the length, to find out the ſolidity of any Parallelopipedon, Cylinder, or other ſolid Figures.

The third Effect is by the Contents, Price, Value, Buying, Selling, Expence, Wages, Exchange, Simple Intereſt, Gain, or Loſs of any one thing, be it Money, Merchandiſe, *&c.* to find out the Value, Price, Expence, Buying, Selling, Exchange, or Intereſt of any *Number* of things of the like Name, Nature and Kind.

The fourth Effect is (not much unlike the other) by the Contents, Value, or Price of one part of any thing Denominated, to find out the Content, Value, or Price of the whole

whole thing, all the parts into which the whole is divided, multiplying the price of one of those parts.

The fifth Effect is, to aid, to compound, and to make other Rules, as chiefly the Rule of Proportion, called the Golden Rule, or Rule of Three; also by it things of one Denomination are reduced to another.

If you multiply any Number of Integers, by the price of the Integer, the Product will discover the price of the Quantity, or Number of Integers given.

In a Rectangular Solid, if you multiply the breadth of the Base by the depth, and that Product by the length, this last Product will discover the Solidity or Content of the same Solid.

Some Questions proper to this Rule may be these following.

Quest. 1. What is the Content of a square piece of Ground, whose length is 28 Perches, and breadth 13 Perches?

Answ. 364 square Perches, for multiplying 28 the length, by 13 the breadth, the Product is so much.

Quest. 2. There is a square Battel whose Flank is 47 Men, and the Files 19 deep,

what Number of Men doth that Battel con-tain? *Facit* 893; for multiplying 47 by 19, the Product is 893.

Quest. 3. If any one thing cost 4 Shillings, what shall 9 such things cost? *Answer*, 36 Shillings; for multiplying 4 by 9, the Product is 36.

Quest. 4. If a piece of Money or Merchandize be worth or cost 17 Shillings, what shall 19 such pieces of Money or Merchandize cost? *Facit* 323 Shillings, which is equal to 16 *l.* 03 *s.*

Quest. 5. If a Soldier or Servant get or spend 14 *s. per* Month, what is the Wages or Charges of 49 Soldiers or Servants for the same time? Multiply 49 by 14, the Product is 686 *s.* or 34 *l.* 06 *s.* for the *Answer.*

Quest. 6. If in a day there are 24 hours, how many hours are there in a year, accounting 365 days to constitute the year? *Facit* 8760 hours, to which if you add the 6 hours over and above 365 days, as there is in a year, then it will be 8766 hours; now if you multiply this 8766, by 60 the Number of minutes in an hour, it will produce 525960 for the Number of Minutes in a Year.

CHAP. VII.

Of Division of whole Numbers.

1. DIVISION is the Separation or Parting of any Number, or Quantity given, into any Parts aſſigned: Or to find how often one Number is contained in another: Or from any two Numbers given to find a third that ſhall conſiſt of ſo many Units, as the one of thoſe two given Numbers is comprehended or contained in the other.

2. Diviſion hath three Parts or Numbers Remarkable, *viz.* Firſt the Dividend, Secondly the Diviſor, and Thirdly the Quotient. The Dividend is the Number given to be Parted or Divided. The Diviſor is the Number given, by which the Dividend is divided: Or it is the Number which ſheweth how many parts the Dividend is to be divided into. And the Quotient is the Number produced by the Diviſion of the

two given Numbers, the one by the other.

So 12 being given to be divided by 3, or into 3 equal parts, thy Quotient will be 4, for 3 is contained in 12 four times, where 12 is the Dividend, and 3 is the Divisor, and 4 is the Quotient.

3. In Division set down your Dividend, and draw a crooked Line at each end of it, and before the Line at the left hand, place the Divisor, and behind that on the right hand, place the Figures of the Quotient, as in the Margin, where it is required to Divide 12 by 3; First I set down 12 the Dividend, and on each side of it do I draw a crooked Line, and before that on the left hand do I place 3 the Divisor; then do I seek how often 3 is contained in 12, and because I find it 4 times, I put four behind the crooked Line on the right hand of the Dividend, denoting the Quotient.

3) 12 (4

4. But if when the Divisor is a single Figure, the Dividend consisteth of two or more places, then (having placed them for the Work as is before directed) put a point under the first Figure on the left hand of the Dividend, provided it be bigger than (or equal to) the Divisor, but if it be lesser than the Divisor, then put a point under the second Figure from the left hand of the Dividend,

vidend, which Figures, as far as the point goeth from the left hand, are to be reckoned by themſelves, as if they had no dependance upon the other part of the Dividend, and for diſtinction ſake may be called the Dividual, then ask how often the Diviſor is contained in the Dividual, placing the Anſwer in the Quotient; then Multiply the Diviſor by the Figure that you placed in the Quotient, and ſet the Product thereof under the Dividual; then draw a Line under that Product, and ſubſtract the ſaid Product from the Dividual, placing the Remainder under the ſaid Line; then put a point under the next Figure in the Dividend, on the right hand of that which you put the point before, and draw it down, placing it on the right hand of the Remainder, which you found by Subſtraction, which Remainder with the ſaid Figure annexed before it, ſhall be a new Dividual; then ſeek again how often the Diviſor is contained in this new Dividual, and put the Anſwer in the Quotient on the right hand of the Figure which you put there before; then Multiply the Diviſor by the laſt Figure that you put in the Quotient, and ſubſcribe the Product under the Dividual, and make Subſtraction, and to the Remainder draw down the next Figure from the grand Dividend, (having firſt

put a point under it,)and put it on the right hand of the Remainder, for a new Dividual, as before, *&c.* and proceed thus till the Work is finiſhed.

Obſerving this general Rule in all kinds of Diviſion, firſt to ſeek how often the Diviſor is contained in the Dividual; then(having put the Anſwer in the Quotient)multiply the Diviſor thereby, and ſubſtract the Product from the Dividual. An Example or two will make the Rule Plain: Let it be required to divide 2184 by 6. I diſpoſe of the Numbers given as is before directed, and as you ſee in the Margent, in order to the Work; then (becauſe 6 the Diviſor is more than 2 the firſt Figure of the Dividend) I put a point under 1 the ſecond Figure, which makes 21 for the Dividual; then do I ask how often 6 the Diviſor, is contained in 21, and becauſe I cannot have it more than three times, I put 3 in the Quotient, and thereby do I multiply the Diviſor (6) and the Product is 18, which I ſet in order under the Dividual and ſubſtract it threefrom, and the Remainder (3) I place in order under the Line, as you ſee in the Margent.

```
6)2184(3
   .

6)2184(3
  18
  --
   3
```

Then do I make a point under the next Figure

Figure of the Dividend, being 8, and draw it down, placing it before the remainder 3; so have I 38 for a new Dividual; then do I seek how often 6 is contained in 38; and because I cannot have more than 6 times, I put 6 in the Quotient, and thereby do I multiply the Divisor 6, and the Product (36) I put under the Dividual (38) and substract it therefrom, and the remainder 2 I put under the Line as you see in the Margent.

```
6)2184(36
  ..
 18
 ——
 38
 36
 ——
  2
```

Then do I put a point under the next (and last) Figure of the Dividend (being 4) and draw it down to the remainder 2, and putting it on the right hand thereof, it maketh 24 for a new Dividual; then I seek how often 6 is contained in 24, and the Answer is 4, which I put in the Quotient, and multiply the Divisor (6) thereby; and The Product (24) I put under the Dividual (24) and subtract it therefrom, and the remainder is 0, and thus the Work is finished, and I find the Quotient to be 364; that is, 6 is contained in 2184 just 364 times, or 2184

```
6)2184(364
  ...
 18
 ——
  33
  35
 ——
   24
   24
 ——
   00
```

being divided into 6 equal parts, 364 is one of those parts.

Again; if it were required to divide 2646 by 7, or into 7 equal parts, the Quotient would be found to be 378, as by the following Operation appeareth.

7)2646(378
21
———
54
49
———
56
56
———
00

So if it were required to divide 946 by 8, the Quotient will be found to be 118, and 2 remaining after Division is ended. The Work followeth.

8) 946 (118
8
———
14
8
———
66
64
———
(2)

Many

Many times the Dividend cannot exactly be divided by the Divisor, but something will remain, as in the last Example, where 946 was given to be divided by 8, the Quotient was 118, and there remaineth 2 after the division is ended. Now what is to be done in this case with the Remainder, the Learner shall be taught when we come to treat of the Reducing (or Reduction) of Fractions.

And here Note that if after your division is ended, any thing do remain, it must be lesser than your Divisor, for otherwise your Work is not rightly performed.

Other Examples are such as follow.

```
8) 73464 (9183          9) 13758 (1528
   ....                     ....
   72                       9
   --                       --
    14                      47
     8                      45
    --                      --
     66                      25
     64                      18
     --                      --
      24                      78
      24                      72
      --                      --
     (0)                     (6)
```

5. But if the Divisor consisteth of more places than one, then chuse so many Figures from the left side of the Dividend for a Dividual as there are Figures in the Divisor, and put a point under the farthest Figure of that Dividual to the right hand, and seek how often the first Figure on the left side of the Divisor, is contained in the first Figure on the left side of the Dividual, and place the Answer in the Quotient, and thereby multiply your Divisor, placing your Product under your Dividual, and substract it therefrom, placing the Remainder below the Line; then put a point under the next Figure in the Dividend, and draw it down to the said Remainder, and annex it on the right side thereof, which makes a new Dividual, and proceed as before, till the Work is finished.

And if so it happen that after you have chosen your first Dividual (as is before directed) you find it to be lesser than the Divisor, then put a point under a Figure more near to the right hand, and seek how often the first Figure on the left side of the Divisor, is contained in the two first Figures on the left side of the Dividual, and place the Answer in the Quotient, by which multiply the Divisor, and place the Product thereof in order under the Dividual, and substract it therefrom, and proceed as before. Al-

Always remembring, that (in all the cases of Division) if after you have multiplied your Divisor by the Figure last placed in the Quotient, the Product be greater than the Dividual; then you must cancel that Figure in the Quotient, and instead thereof put a Figure lesser by a Unit (or one) and multiply the Divisor thereby; and if still the Product be greater than the Dividual, make the Figure in the Quotient yet lesser by a Unit, and thus do, until your Product be lesser than the Dividual, or at the most equal thereto; and then make Substraction, &c.

So if you would divide 9464 by 24, the Quotient will be found to be 394, I first put down the given Numbers, as before is directed in the third Rule: Now because my Divisor consisteth of two Figures, I therefore put a point under the second Figure from the left hand in my Dividend, which here is 4; wherefore I seek how often 2 the first Figure (on the left side of the Divisor) is contained in 9 (the like first in the Dividual,) the Answer is 4, which I put in the Quotient, and thereby multiply all the Divisor, and find the Product to be 96, which is greater than the Dividual 94; wherefore I cancel the 4 in the

24)9464(	3
	~~4~~
72	
——	
22	

Quotient,

Quotient, and inſtead thereof, I put 3 (a Unit leſſer,) and by it multiply the Diviſor 24, and the Product is 72, which I ſubſtract from 94 the Dividual, and the remainder is 22; then do I make a point under the next Figure 6 in the Dividend, and draw it down, and place it on the right ſide of the remainder 22, and it makes 226 for a new Dividual: Now becauſe the Dividual 226 conſiſteth of a Figure more than the Diviſor, therefore I ſeek how often 2 (the firſt Figure of the Diviſor) is contained in 22 (the two firſt of the Dividual,) I ſay nine times; wherefore I put 9 in the Quotient, and thereby multiply the Diviſor 24, the Product (216) I place under the Dividual 226, and ſubſtract it from it, and there remaineth 10.

```
24) 9464) 39
     ..
     72
     --
     226
     216
     ---
      10
```

Then I go on, and make a point under the next and laſt Figure (4) in the Dividend, and draw it down to the remainder 10, and it maketh 104, for a new Dividual, which is alſo a Figure more than the Diviſor, and therefore I ſeek how often 2 is contained in 10, I anſwer five times; but multiplying my Diviſor by 5, the Product is 120, which

which is greater than the Diviſor, and therefore I make it but 4, and by it multiply the Diviſor, and the Product is 96; which being placed under, and ſubſtracted from the Dividual there remaineth 8; and thus the whole Work of this Diviſion is ended, and I find that 9464 being divided by 24, or into 24 equal parts, is found to be 394, as was ſaid before, and the remainder is 8, as you ſee in the Margent.

```
24) 9464 (394
     ...
    72
    ——
    226
    216
    ———
     104
      96
     ———
     (8)
```

Another Example may be this, let there be required the Quotient of 1183653 divided by 385: Firſt I diſpoſe of the Numbers in order to their dividing; and becauſe 118, the three firſt Figures of the Dividend, is leſſer than the Diviſor 385, I therefore make a point under the fourth Figure, which is 3, and ſeek how often 3 (the firſt Figure of the Diviſor) is contained in 11: The Anſwer is 3, which I put in the Quotient, and thereby multiply the Diviſor 385, and the Product is 1155, which I ſubſtract from

```
385) 1183653 (3
        .
     1155
     ————
       28
```

from the Dividual 1183, and there remains 28. Then (as before) I draw down the next Figure, which is 6 and place it before the remainder 28, ſo have I 286 for a new Dividual; and becauſe it hath no more Figures than the Diviſor, I ſeek how often 3 (the firſt Figure in the Diviſor) is contained in 2 (the firſt Figure of the Dividual) and the Anſwer is 0, for a greater Number cannot be contained in a leſſer; wherefore I put 0 in the Quotient, and thereby (according to the 5th Rule) I ſhould multiply my Diviſor, but if I do, the Product will be 0, and 0 ſubſtracted from the Dividual 286, the remainder is the ſame; wherefore I draw down the next Figure (5) from the Dividend, and put it before the ſaid remainder 286, ſo have I 2865 for a new Dividual; and becauſe it conſiſteth of four places) (*viz.*) a place more than the Diviſor, I ſeek how often 3 (the firſt Figure of the Diviſor) is contained in 28 (the two

```
385) 1183653 (30
        ..
     1155
     ----
      286
```

```
385) 1183653 (307
        ...
     1155
     ----
     2865
     2695
     ----
      170
```

two first of the Dividual) and I say there is 9 times 3 in 28, but multiplying my whole Divisor (385) thereby, I find the Product to be 3465, which is greater than the Dividual 2865; wherefore I chuse eight, which is lesser by a Unit than nine, and thereby I multiply my divisor 385, and the Product is 3080, which still is greater than the said Dividual; wherefore I choose another Number yet a Unit lesser, *viz.* 7; and having multiplied my Divisor thereby, the Product is 2695, which is lesser than the Dividual 2865, wherefore I put seven in the Quotient, and substract 2695 from the Dividual 2865, and there remains 170; then I draw down the last Figure (3) in the Dividend, and place it before the said Remainder 170, and it makes 1703 for a new Dividual; then (for the Reason abovesaid) I seek how often three is contained in 17, the Answer is 5, but multiplying the Divisor thereby, the Product is (1925,) greater than the Dividual, wherefore I say it will bear 4 (a Unit lesser) and by

```
385)118653(3074
      ....
    1155
    ----
     2865
     2695
     ----
      1703
      1540
      ----
       163
```

it

it I multiply the divisor 385, and the Product is 1540, which is lesser than the Dividual; and therefore I put 4 in the Quotient, and substract the said Product from the Dividual, and there remaineth 163, and thus the Work is finished, and I find that 1183653, being divided by 385, or into 385 equal shares, or parts, the Quotient (or one of those parts) is 3074, and besides there is 163 Remaining.

And thus the Learner being well versed in the Method of the foregoing Examples, he may be sufficiently qualified for the dividing of any greater Summ or Number into as many parts as he pleaseth, that is, he may understand the method of dividing by a Divisor which consisteth of 4, or 5, or 6, or any greater number of places, the method being the same with the foregoing Examples in every Respect.

Other

Other Examples of Division.

```
27986) 835684790 (29860
           ....
       55972
       ------
       275964
       251874
       ------
        240907
        223888
        ------
        170199
        167916
        ------
Remains (22830)
```

```
196374) 473986018 (2413
            ....
          392748
          ------
          812380
          785496
          ------
           268841
           1966374
           -------
            724678
            589122
            ------
Remains (135556)
```

So

So if you divide 47386473 by 58736, you will find the Quotient to be 806, and 45257 will remain after the Work is ended.

In like manner if you would divide 3846739204 by 483064, the Quotient will be 7963, and the remainder after Division will be 100572.

Compendiums in Division.

1. IF any given Number be to be divided by another Number that hath Cyphers annexed on the right side thereof, (omitting the Cyphers) you may cut off so many Figures from the right hand of the Dividend, as there are Cyphers before the Divisor, and let the remaining Numbers in the Dividend, be divided by the remaining Number or Numbers in the Divisor; observing this Caution, that if after your Division is ended, any thing remain, you are to annex thereto the Number or Numbers that were cut off from the Dividend; and such new found Number shall be the remainder.

Et si Divisor adjunctos sibi habeat Circulos ad dextram, omissis circulis & abscissis totidem ultimis Figuris dividendi, in numeris reliquis fiat divisio, in fine autem divisionis restituendi sunt tum omissi circuli tum figuræ abscissæ. Ought. Cla. Math. cap. 5. 3.

der. As for Example: Let it be required o divide 46658 by 400; now becauſe here are two Cyphers before the Diviſor, I cut off as many Figures from before the Dividend, *viz.* 58, ſo that then there will remain only 466 to be divided by 4, and the Quotient will be 116, and there will remain 2, to which annex the two Figures (58) which were cut off from the Dividend, and it makes 258 for the true Remainder; ſo that I conclude 46658, being divided by 400, he Quotient will be 116, and 258 remaineth after the Work is ended, as by he Work in the Margent.

```
4|00)466|58(116
      ..
      4
     ---
      6
      4
     ---
      26
      24
     ---
      258
```

2. And hence it followeth that if the Diviſor be (1) or a Unit, with Cyphers annexed, you may cut off ſo many Figures from before the Dividend, as there are Cyphers in the diviſor, and then the Figure or Figures that are on he left hand, will be the Quotient, and thoſe that

Diviſurus quemcunque numerum per 10. aufer ex dextra parte unicam, eamque primam figuram: Reliquæ enim figuræ productum oſtendunt. Ablatum reſiduum, &c. Gem. Friſ. Arith. part. 1.

that are on the right hand will be the Remainder, after the Division is ended: As thus, if 45783 were to be divided by 10, I cut off the last Figure (3) with a dash thus (4578|3) and the Work is done, and the Quotient is 4578 (the Number on the left hand of the dash,) and the Remainder is 3 (on the right hand;) in like manner if the same Number 45783 were to be divided by 100, I cut off 2 Figures from the end thus (457|83,) and the Quotient is 457, and the Remainder is 83. And if I were to divide the same by 1000, I cut off 3 Figures from the end thus (45|783) and the Quotient is 45, and 783 the Remainder, *&c.*

6. The general Effect of Division is contained in the definition of the same (that is) by having two unequal Numbers given to find a third Number in such Proportion to the Dividend, as the Divisor hath to Unit, or 1; it also discovers what reason or proportion there is between Numbers, so if you divide 12 by 4 it quotes 3, which shews the reason, or proportion of 4 to 12 is triple.

The second Effect is by the Superficial measure or content, and the length of any Oblong, rectangular Parallelogram or square Plain known, to find out the breadth thereby; or contrariwise by having the Superficies, and breadth of the said Figure, to find out

out the length thereof. Alſo by having the ſolidity and length of a ſolid, to find the Superficies of the Baſe, *& contra.*

The third Effect is, by the Contents, Reaſon, Price Value, Buying, Selling, Expences, Wages, Exchange, Intereſt, Profit, or Loſs of any Number of things (be it Money, Merchandize, or what elſe) to find out the Contents, Reaſon, Price, Value Buying, Selling, Expence, Wages, Exchange, Intereſt, Profit or Loſs, of any one thing of like kind.

The fourth Effect is to Aid, to Compoſe, and to Make other Rules, but principally the Rule of Proportion, called the Golden Rule, or Rule of Three, and the Reduction of Money, Weights and Meaſures, of one Denomination into another, by it alſo Fractions are abbreviated by finding a common meaſurer unto the Numerator and Denominator, thereby diſcovering commenſurable Numbers.

If you divide the Value of any certain quantity, by the ſame quantity, the Quotient diſcovers the Rate or Value of the Integer, as if eight yards of Cloth coſt 29 ſhillings; if you divide (96) the Value or Price of the given quantity, by (8) the ſame quantity, the Quotient will be 128, which is the Value or Price of 1 of thoſe yards, *& contra.*

If you divide the Value or Price of any unknown

unknown quantity, by the Value of the Integer, it gives you in the Quotient that unknown quantity whose Price is thus divided; and if 12 shillings were the Value of 1 yard, I would know how many yards are worth 96 shillings; here if you divide (96) the Price or Value of the unknown quantity, by (12) the Rates of the Integer, or one yard, the Quotient will be 8, which is the Number of yards, worth 96 shillings.

Some Questions answered by Division may be these following.

Quest. 1. If 22 things cost 66 shillings, what will 1 such like thing cost? *facit* 3 shillings; for if you divide 66 by 22, the Quotient is 3 for the Answer; so if 26 yards or ells of any thing be bought or sold for 108*l.* how much shall one yard or ell be bought or sold for? *facit* 3*l.* for if you divide 108*l.* by 36 yards, the Quotient will be 3*l.* the Price of the Integer.

Quest. 2. If the Expence, Charges, or Wages of 7 years amount to 868*l.* what is the Expence, Charges, or Wages of one year? *facit* 124*l.* for if you divide 868 (the Wages of 7 years) by 7 (the Numbers of years,) the Quotient will be 124 *l.* for the Answer. See the Work.

7) 868 (124
7
16
14
28
28
00

Quest. 3. If the content of a ſuperficial Foot be 144 Inches, and the breadth of a board be 9 Inches, how many Inches of that board in length will make ſuch a Foot? *Facit* 16 Inches; for by dividing 144 (the Number of ſquare Inches in a ſquare Foot,) by 9, (the Inches in the breadth of the board,) the Quotient is 16 for the Number of Inches in length of that board, to make a ſuperficial Foot.

9) 144 (16 *Inches.*
9
54
54
00

Queſt. 4. If the content of an Acre of Ground be 160 ſquare Perches, and the length of a Furlong (propounded) be 80 Perches,

Perches, how many Perches will there go in breadth to make an Acre, *facit* 2 Perches; for if you divide 160 (the number of Perches in an Acre) by 80 (the length of the Furlong in Perches) the Quotient is 2 Perches; and so many in breadth of that Furlong will make an Acre.

80) 160 (2 Perches

160

(0)

Quest. 5. If there be 893 Men to be made up into a Battel, the Front consists of 47 Men, what Number must there be in the File? *Facit* 19 deep in the File: For if you divide 893 (the *Number* of Men) by 47 (the Number in Front) the Quotient will be 19 File in depth; the Work followeth.

47) 893 (19 *deep in File.*

47

423
423

(0)

Quest.

Quest 6. There is a Table whose superficial Content is 72 Feet, and the breadth to it at the end is 3 Feet; now I demand what is the length of this Table? *Facit* 24 Feet long; for if you divide 72 (the Content of the Table in Feet) by 3 (the breadth of it) the Quotient is 24 Feet for the length thereof, which was required. See the Operation as followeth.

```
3) 72 (24
   6
   --
   12
   12
   --
   (0)
```

The Proof of Multiplication and Division.

Multiplication and Division interchangeably prove each other; for if you would prove a summ in Division, whether the Operation be right or no, multiply the Quotient by the Divisor; and if any thing remain after the Division was ended, add it to the Product, which Product (if your summ was rightly divided) will be equal to the Dividend; and contrariwise, if you would

prove a summ in Multiplication, divide the Product by the Multiplier; and if the Work was rightly performed, the Quotient will be equal to the Multiplicand. See the Example where the Work is done and undone: Let 7654 be given to be multiplied by 3242, the Product will be 24814268, as by the Work appeareth.

```
    7654
    3242
    ----
   15308
  30616
 15308
22962
--------
24814268
```

And then if you *divide* the said Product 24814268 by 3242 the Multiplier, the Quotient will be 7654 equal to the given Multiplicand.

```
3242) 24814268 (7654
      22694
      -----
       21202
       19452
       -----
        17506
        16210
        -----
         12968
         12968
         -----
          (0)
```

In like manner, (to prove a Summ or Number in Division) if 24814268 were divided by 3242, the Quotient would be found to be 7654; then for proof, if you multiply 7654 the Quotient, by 3242 the Divisor, the Product will amount to 24814268, equal to the Dividend.

Or you may prove the last, or any other Example in Multiplication thus, *viz.* Divide the Product by the Multiplicand, and the Quotient will be equal to the Multiplier. See the Work.

```
              7654
              3242
            ------
             15308
            30616
           15308
          22962
         ---------
7654) 24814268 (3242
          22962
         ------
          18522
          15308
         ------
           32146
           30616
          ------
            15308
            15308
           ------
             (0)
```

From whence there ariseth this Corollary, That any Operation in Division may be proved by Division; for if after your Division is ended, you divide the Dividend by the Quotient, the new Quotient thence arising will be equal to the Divisor of the first Operation; for Trial whereof let the last Example be again repeated.

[324

3242) 24814268 (7654

22694

21202
19452

17506
16210

12968
12968

(0)

For Proof whereof divide again 24814268 by the Quotient 7654, and the Quotient hence will be equal to the first Divisor 3242. See the Work.

7654) 24814268 (3242

22962

18522
15308

32146
30616

15308
15308

(0)

But in proving Division by Division, the Learner is to obſerve this following Caution, that if after his *Diviſion* is ended there be any remainder, before you go about to prove your Work, ſubſtract that remainder out of your Dividend, and then work as before, as in the following Example, where it is required to divide 43876 by 765, the Quotient here is 57, and the remainder is 271. See the Work following.

765) 43876 (57
3825
5626
5355
(271)

Now to prove this Work, ſubſtract the remainder 271 out of the Dividend 43876, and there remaineth 43605 for a new Dividend, to be divided by the former Quotient 57, and the Quotient thence ariſing is 765 equal to the given Diviſor, which proveth the Operation to be right.

(o)

```
        43876
          271
      ─────────
57)   43605 (765
      399
     ───────
        370
        342
       ─────
         285
         285
        ─────
         (0)
```

Thus have we gone through the four Species of Arithmetick, *viz.* Addition, Substraction, Multiplication, and Division; upon which all the following Rules, and all other Operations whatsoever, that are possible to be wrought by Numbers, have their immediate dependance, and by them are resolved. Therefore before the Learner make a farther step in this Art, let him be well acquainted with what hath been delivered in the foregoing Chapters.

Hæ sunt igitur quatuor illæ species arithmetices, per quas omnia quæcunque deinceps dicenda sunt, vel quæ per numeros fieri possibile est, absolvuntur. Quare eas, quisquis es, ante omnia perdisces. Gem. Fris. Arith. par. 1.

CHAP. VIII.

Of Reduction.

1. REDUCTION, is that which brings together 2 or more Numbers of different denominations into one denomination; or it serveth to change or alter Numbers, Mony, Weight, Measure, or Time, from one denomination to another; and likewise to abridge Fractions to their lowest Terms. All which it doth so precisely, that the first Proportion remaineth without the least jot of Error or Wrong committed. So that it belongeth as well to Fractions as Integers, of which in its proper place. Reduction is generally performed, either by Multiplication or Division; from whence we may gather, that,

Hill's Arith. Ch. 13. 152.

2. Reduction is either descending or ascending.

3. Reduction descending, is when it is required to reduce a Summ or Number of a greater denomination, into a lesser; which Number,

Number, when it is so reduced, shall be equal in value to the Number first given in the greater denomination; as if it were required to know how many Shillings, Pence, or Farthings are equal in value to an hundred Pounds; or how many Ounces are contained in 45 hundred Weight; or how many Days, Hours, or Minutes, there are in 240 Years, *&c.* And this kind of Reduction is generally performed by Multiplication.

Wing. Arith. Ch. 7. 2,3,4.

4. Reduction ascending, is when it is required to reduce or bring a Summ or Number of a smaller Denomination into a greater, which shall be equivalent to the given Number; as suppose it were required to find out how many Pence, Shillings, or Pounds, are equal in value to 43785 Farthings; or how many hundreds are equal to (or in) 3748 Pounds, *&c.* and this kind of Reduction is always performed by Division.

5. When any Summ or Number is given to be reduced into another denomination, you are to consider whether it ought to be resolved by the Rule descending, or ascending, *viz.* by Multiplication or Division: If it were to be performed by Multiplication, consider how many parts of the

nomination into which you would reduce it, are contained in a Unit or Integer of the given Number, and multiply the said given Number thereby, and the Product thereof will be the Answer to the Question: As if the Question were in 38 Pounds, how many Shillings? Here I consider, that in one Pound are 20 Shillings, and that the Number of Shillings in 38 Pounds will be 20 times 38; wherefore I multiply 38 Pounds by 20, and that Product is 760; and so many Shillings are contained in 38 Pounds, as in the Margent.

38
20
———
760

But when there is a Denomination, or Denominations between the Number given, and the Number required, you may (if you please,) reduce it into the next inferior Denomination, and then into the next lower than that, &c. until you have brought it into the Denomination required. As for Example, let it be demanded in 132 Pounds, how many Farthings? First, I multiply 132 (the Number of Pounds given) by 20, to bring it into Shillings, and it makes 2640 Shillings; then do I multiply the Shillings (2640) by 12, to bring them into Pence,

132 *Pounds.*
20
———
2640 *Shill.*
12
———
5280
2640
———
31680 *Pence.*
4
———
126720 *Farth.*

and

and it produceth 31680, and so many Pence are contained in 2640 Shillings; or 132 Pounds; then do I multiply the Pence, *viz.* 31680 by 4, to bring them into Farthings, (because 4 Farthings is a Penny,) and I find the Product thereof to be 126720, and so many Farthings are in equal value to 132 Pounds: the Work is manifest in the Margent.

6. And if the Number propounded to be reduced, is to be divided, or wrought by the Rule ascending, consider how many of the given Numbers are equal to an Unit or Integer, in that denomination to which you would reduce your given Number, and make that your Divisor, and the given Number your Dividend; and the Quotient thence arising will be the Number sought or required. As for Example; let it be required to reduce 2640 Shillings into Pounds; here I consider that 20 Shillings are equal to one Pound; wherefore I divide 2640 (the given Number) by 20, and the Quotient is 132, and so many Pounds are contained in 2640 Shillings. In Reduction descending and ascending, the Learner is advised to take particular notice of the Tables delivered in the second Chapter of

l.
2|0)264|0(132
2
6
6
4
4
(0)

this Book, where he may be informed what Multipliers or Divisors to make use of in the reducing of any Number to any other denomination whatsoever; especially *English* Moneys, Weights, Measures, Time and Motion; but in this place is is not convenient to meddle with foreign Coins, Weights, or Measures.

But if in Reduction ascending, it happen that there is a denomination, or denominations, between the Number given, and the Number required, then you may reduce your Number given into the next superior denomination; and when it is so reduced, bring it into the next above that; and so on, until you have brought it into the denomination required. As for Example,

Let it be demanded in 126720 Farthings, how many Pounds? First, I divide my given Number (being Farthings) by 4, to bring them into Pence, (because 4 Farthings make one Penny,) and they are 31680 Pence; then I divide 31680 Pence by 12, and the Quotient giveth 2640 Shillings; and then I divide 2640 Shillings by 20, and the Quotient giveth 132 Pounds, which are equal in value to 126720 Farthings. See the whole Work as it followeth.

```
             12)        2|0)     l.
4) 126720  (31680  (264|0  (132.
   .....     ...      ..
   12        24       2
   --        --       --
    6        76       6
    4        72       6
   --        --       --
   27        48       4
   24        48       4
   --        --       --
   32       (0)      (0)
   (0)
   --
```

7. When the Number given to be reduced, consisteth of divers denominations, as Pounds, Shillings, Pence and Farthings, or of Hundreds, Quarters, Pounds and Ounces, *&c.* then you are to reduce the highest (or greatest) denomination into the next Inferiour, and add thereunto the Number standing in that denomination which your greatest or highest Number is reduced to; then reduce that summ into the next Inferiour denomination, adding thereto the Number standing in that denomination; do so until you have brought the Number given into the denomination proposed. As if it were required to reduce 48 *l.* 13 *s.* 10 *d.* into Pence; First, I bring 48 *l.* into Shillings, by multiplying

multiplying it by 20, and the Product is 960 Shillings, to which I add the 13 Shillings, and they make 973; then I multiply 973 by 12, to bring the Shillings into Pence, and they make 11676 Pence, to which I add the 10 Pence, and they make 11686 Pence for the Answer: See the Work done.

	l.	*s.*	*d.*
	48	13	10
	20		
	960	*Shillings.*	
Add	13		
Summ	973	*Shillings.*	
	12		
	1946		
	973		
	11676	*Pence.*	
Add	10		
Summ	11686	*Pence.*	

18. If (in Reduction Ascending (after Division is ended, any thing remain, such Remainder is of the same denomination with the Dividend,

Example, In 4783 Farthings, I demand many how Pounds.

First, I divide the given Number of Farthings

things, (*viz.* 4783) by 4, to bring them into Pence, and the Quotient is 1195 Pence, and there remaineth 3 after the Work of Division is ended, which is 3 Farthings.

Again, I divide 1195 Pence (the said Quotient) by 12, to reduce them into Shillings, and the Quotient is 99 Shillings, and there is a Remainder of 7, which is 7 Pence.

And then I divide 99 Shillings (the last Quotient) by 20, to bring it into Pounds, and the Quotient is 4 Pound, and there remaineth 19 Shillings; so that I conclude that in 4783 (the proposed Number of Farthings) there is 4 Pounds, 19 Shillings, 7 Pence, 3 Farthings; view the following Operation.

```
                     12)         20)
4) 4783             (1195      (9|9 (4 Pounds.
   ...                ..
    4                108        8|
   ---              ----       ----
    07               115       (19) Shillings.
     4               108
   ----             ----
    38       Rem.   (7) Pence.
    36
   ----                      l.  s.  d.  qrs.
     23             Facit  04--19--07--03
     20
   ----
Remains (3) Farthings.
```

More

More Examples in Reduction of Coin.

Quest. 1. In 438*l.* how many Shillings? *Facit* 8760 Shillings, for by multiplying 438 by 20, the Product amounteth to so much: See the Work.

	438 *Pounds.*
	20
Facit	8760 *Shillings.*

Quest. 2. In 467*l.* how many Pence? First, multiply the given Number of Pounds (467) by 20, to bring it into Shillings, and it makes 9340 Shillings, then multiply the Shillings by 12, and it produceth 112080 Pence; thus,

	467 *Pounds.*
	20
	9340 *Shillings.*
	12
	18680
	9340
Facit	112080 *Pence.*

Or it may be resolved thus, *viz.* multiply the given Number of Pounds (467) by (240) the Number of Pence in a Pound, and the

the Product is the same, *viz.* 112080 Pence, as by the Operation appeareth.

467 *Pound.*
240
18680
934
Facit 112080 *Pence.*

Quest. 3. In 5673*l.* how many Farthings? First, multiply the given Number by 20, to bring it into Shillings, and it produceth 113460 Shillings, then multiply that Product by 12, to bring it into Pence, and it produceth 1361520 Pence; then Lastly, multiply the Pence by 4, and it produceth 5446080 Farthings. See the Operation.

5673 *Pounds.*
20
113460 *Shillings.*
12
226920
113460
1361520 *Pence.*
4
Facit 5446080 *Farthings.*

Or

Or this Question might have been thus resolved, *viz.* multiply 5673 (the given Number of Pounds) by 960 (the Number of Farthings in a Pound) and it produceth the same Effect, as you may see by the Work.

5673 *Pounds.*		20 *Shillings.*
960		12
340380		240 *Pence.*
51057		4
Facit 5446080	*Farthings.*	960 *Farthings.*

Otherwise thus; First, bring the given Number 5673*l* into Shillings, and multiply the Shillings by 48, the Number of Farthings in a Shilling, and the same Effect is thereby likewise produced, *viz.*

5673 *Pounds.*		12 *Pence.*
20		4
113460 *Shillings.*		48 *Farth.*
48		
907680		
453840		
5446080 *Farthings.*		

These various ways of Operating are expressed to inform the Judgment of the Lear-

ner, with the Reason of the Rule; more ways may be shewn, but these are sufficient even for the meanest Capacities.

Quest. 4. In 458*l.* 16 *s.* 07 *d.* 3 *qrs.* how many Farthings? To resolve this Question consider the seventh Rule of this Chapter, and work as you are there directed, and you will find the aforesaid given Number to amount to 440079 Farthings, *viz.*

	l.	s.	d.	qrs.
	458	16	07	3
	20			
	9160			
Add	16	*Shillings.*		
Summ	9176	*Shillings.*		
	12			
	18352			
	9176			
	110012			
Add	07	*Pence.*		
Summ	110019	*Pence.*		
	4			
	440076			
Add	3	*Farthings.*		
Summ	440079	*Farthings.*		

This

This last Question (or any other of this kind, *viz.* where the Number given to be reduced consisteth of several denominations) may be more concisely resolved thus, *viz.* when you multiply the Pounds by 20, to bring them into Shillings, to the Product of the first Figure add the Figure standing in the place of Units in the denomination of Shillings, but because the first Figure in the Multiplier is (0) I say 0 times 8 is nothing, but 6 is 6, which I put down for the first Figure in the Product; then because this Multiplier is 0, I go on no further with it, for if I should, the whole Product would be 0, but proceed, and when I come to multiply by the second Figure in the Multiplier, and to the Product of it I add the Figure standing in the place of Tens in the denomination of Shillings, which is (1) saying 2 times 8 is 16, and (the said Figure) 1 is 17, then I set down 7, and carry a Unit to the Product of the next Figure, as is directed in the fifth Rule of the sixth Chapter foregoing; and finish the Work. So that you now have the whole Product and Summ of Shillings at one operation, which is the same as before, and when you multiply the Shillings by 12, to bring them into Pence, (after the same manner) add to the Product, the Number standing in the denomination of Pence, and so when you multiply

multiply the Pence by four to bring them into Farthings, add to the Product the Number ſtanding under the denomination of Farthings: See the laſt Queſtion thus wrought.

l.	*s.*	*d.*	*qrs.*
458	16	07	3

```
   458--16--07---3
    20
  ----
  9176 Shillings.
    12
  -----
 18352
  9176
 ------
 110119 Pence.
      4
 ------
Facit 440476 Farthings.
```

After the Method laſt preſcribed (which if Rightly conſidered, differeth not any thing from the *7th.* Rule of this Chapter) are all the following Examples that are of the ſame Nature wrought and reſolved.

Queſt. 5. In 4375866 Farthings, I demand how many Pounds, Shillings, Pence, and Farthings?

To reſolve this Queſtion; Firſt, I divide the given Number of Farthings by 4, and the Quotient is 1093966 Pence, and there remaineth 2 after the Diviſion is ended,

ed, which (by the eighth Rule foregoing) is two Farthings; then I divide 1093966 Pence by 12, and the Quotient is 91163 Shillings, and there remaineth 10 after Division, which by the said eighth Rule is so many Pence, *viz.* 10 *d.* then I divide 91163 Shillings by 20, and the Quotient is 4558*l.* and there remaineth 3 Shillings; so the Work is finished, and I find that in 4375866 Farthings there are 4558*l.* 03 *s.* 10 *d.* 2 *qrs.* See the Operation.

```
                      12)          2|0      l.
4) 4375866   (1093966   (9116|3  (4558
   .....      .....       ...

    4           108         8
   ---         ---        ---
    37          13          11
    36          12          10
   ---         ---        ---
    15          19          11
    12          12          10
   ---         ---        ---
    38          76          16
    36          72          16
   ---         ---        ---
    26          46        (03) Shillings
    24          36
   ---         ---
    26        (10) Pence.
    24
   ---
   (2) Farthings
```

	l.	*s.*	*d.*	*qrs.*
Facit	4558	03	10	2

Quest. 6

Quest. 6. In 4386 *l.* I demand how many Groats?

To resolve this Question, I reduce the given Number of Pounds into Shillings, and they are 87720 Shillings; now I consider that in a Shilling are 3 Groats, therefore I multiply the Shillings by 3, and it produceth 263160 Groats. See the Work.

4386 *Pounds.*
20

87720 *Shillings.*
3

Facit 263160 *Groats.*

This Question might have been otherways resolved thus, *viz.* considering that in a Pound (or 20 Shillings) there are three times 20 Groats, which makes 60, by which I multiply the Number of Pounds given, and it produceth the same Effect at one Operation, as followeth.

4386 *Pounds.*
60 *Groats in* 20 *s.*

Facit 263160 *Groats in* 4386 *l.*

Quest. 7.

Queſt. 7. In 43758 three Pences, I deſire to know how many Pounds ?

To reſolve this (and many ſuch like) Queſtion; Firſt, I divide my given Number of 3 Pences by 4, becauſe 4 three Pences are in a Shilling, and the Quotient is 10939 Shillings; and there remaineth 2 after Diviſion is ended, which is 2 three Pences (by the eighth Rule of this Chapter) which are equal in Value to 6 *d*. then I divide 10939 Shillings by 20, and the quote giveth 546 *l*. and 19 *s*. remain; ſo that I conclude in 43758 Pieces of three Pence *per* Piece, there are 546*l*. 19*s* 06*d*. as by the Work appeareth.

```
                  2|0         l.   s.  d.
4) 43758   (1093|9   (546--19--06
   ....     ..
    4       10
   ---     ---
    37       9
    36       8
   ---     ---
     15     13
     12     12
    ---    ---
      38    19 Shillings.
      36
     ---
(2) three Pences, or 6 d.
```

This Queſtion might have been otherwiſe reſolved

resolved thus, *viz.* first multiply the given Number of three Pences 43758, by 3 the Number of Pence in three pence, and the Product (*viz.* 131274) is the Number of Pence equal to the given Number of three Pences; which Number of Pence may be brought into pounds, by dividing by 12 and by 20, and the Quotient you will find to be equal to the former Work, *viz.* 546 *l.* 19 *s.* 06 *d.*

```
      43758
          3
     ---------2|0)      l.     s.     d.
12)  131274(1093|9  (546---19---06
     .....   ...

      12       10
     ----     ----
     112        9
     108        8
     ----     ----
      47       13
      36       12
     ----     ----
     114(19) shillings rem.
     108
    ----
Remains (6) pence
```

Or thus, divide the given Number of 3 Pences by the Number of 3 Pences in a Pound, or 20 Shillings, (which you will find to be 80, if you multiply 20 *s.* by 4, the Number of 3 Pences in a Shilling,) and you

will find the quote to be 546 *l.* as before, and a remainder of 78 three Pences; and if you divide thoſe 78 three pences by 4, (because there are 4 three Pences in a Shilling,) you will find the quote to be 19 *s.* and 2 three Pences remain, which are equal to 6 *d.* which is the ſame that was before found.

```
                 l.  s.  d.
8|0) 4375|8 (546-19-06          20
     ...                         4
     40                         ---
    ----                        80
     37
     32
    ----
     55
     48
    ---- s.
 4) 78 (19
     ..
     4
    ----
     38
     36
    ----
```

2 *three Pences, or* 6 d.

Queſt. 8. In 4785 *l.* 13 *s.* how many pieces of 13 ½ *d.* *per* piece?

This Queſtion cannot be reſolved by Reduction, deſcending, or aſcending, abſolutely, (becauſe 13½ *d.* is no even part of a Pound) but rather by them both jointly, *viz.* by Multiplication and Diviſion; for if you bring

bring the Number given into half Pence, and divide the half Pence, by the half Pence in $13\frac{1}{2}$ *d. viz.* 27. the Quotient will be the Answer; for having brought 4785 *l.* 13 *s.* into half Pence, I find it makes 2297112, which I divide by 27, (because there are so many half Pence in $13\frac{1}{2}$ *d.*) and the quote gives 85078 pieces of $13\frac{1}{2}$ *d.* and 6 half Pence remain over and above: Observe the Work following.

```
 l.   s.                                  d
4785--13                                13½
   20                                     2
-------                                 ---
 95713 Shillings                        27 half Pence
    24 half Pence in a Shilling
-------
 382852
 191426
-------
2297112 half Pence in the given Number.
                                               d.
27) 2297112 (85078 pieces of 13½
     ....
    216
    ---
     137
     135
     ---
      211
      189
      ---
       222
       216
       ---
Remains (6) half Pence.
```

It would have produced the ſame Anſwer, if you had reduced your given Number into Farthings, and divided by the Farthings in 13½ *d.* *viz.* 54 (foi always the Dividend and the Diviſor muſt be of one denomination) and then you would have had a remainder of 12 Farthings, which are equal in value to the former remainder of 6 half Pence, as you may prove at your leiſure.

Queſt. 9. In 540 Dollars at 4 *s.* 4 *d.* per Dollar, how many Pounds *Sterling*?

First, Bring your given Number of Dol-lars into Pence; and then your Pence into Pounds, according to the former Directions. Thus in 4 *s.* 4 *d.* (*viz.* a Dollar) you wil find 52 Pence, by which multiply 540 Dol-lars, and it produceth 28080 Pence, which if you divide by 240, (the Pence in one Pound) the Quotient will give you 117 which are equal in value to 540 Dollars, at 4 *s.* 4 *d.* *per* Dollar: Obſerve the Operatio

		s. *d.*
540		4—4
52		12
1080		52 *Pence*
2700		
	l.	
24|0) 2808|0	(117	

```
   ...
   24
   ——
   40
   24
   ——
   168
   168
   ——
   (0)
```

The foregoing Question might have been otherwise wrought, thus, *viz.* Multiply (540) your given Number of Dollars, by 13 the Number of Groats in a Dollar, (or 4 *s.* *d.*) and it produceth 7020 Groats; which divide by 60, (the Groats in one Pound or twenty Shillings,) and the quote is 117 *l.* as before. See the Work.

		s. d.
	540	4—4
	13	3
	1620	13
	540	
6|0)	702|0 (117	

```
 6
---
 10
  6
---
 42
 42
---
 (0)
```

Queſt. 10. In 547386 pieces of $4\frac{1}{2}$ *d. per* piece, I demand how many Pounds, Shillings, and Pence?

Firſt, Bring your given Number of four Pence-half-pennies all into half-pence, which you will do, if you multiply by 9, the Number of half pence in $4\frac{1}{2}$ *d.* and the Product is 4926474 half-pence, which are brought into Pounds, if you divide them by 24 (the half-pence in a Shilling) and 20 (the Shillings) in a Pound, it makes 10263 *l.* 09 *s.* 9 *d.* as by the Work.

547386

```
                                        d.
                                        4½
     547386                             2
          9                             —
     ————————2|0)   l.                  9 half-pence
24) 4926474(20526|9(10263
    ...........

    48         2
    ——         ——
    126        05
    120         4
    ———        ——
     64        12                    l.     s.   d.
     48        12          facit 10263 -09 -09
     ——        ——
     167        6
     144        6
     ———       ——
      234 rem.(09) Shillings.
      216
      ———
Rem. (18) half-pence or 9 d.
```

Queſt. 11. In 4386 *l.* I demand how ma-ny pieces of 6 *d.* of 4 *d.* and of 2 *d.* of each in equal Number? That is to ſay, what Number of ſix Pences, Groats, and two-Pences, will make up 4386 *l.* and the Num-ber of each equal?

The way to reſolve Queſtions of this Nature, is, to add the ſeveral pieces (into which the given Number is to be brought) into one ſumm, and to reduce the given Number into the ſame denomination with their ſumm, and to divide the ſaid given Number (ſo reduced) by the ſaid ſumm, and the Quotient will give you the exact Number of each piece. And after the ſame Method will we proceed to reſolve the preſent Queſtion, *viz.*

l.	*d.*
4386	6
240 *Pence*	4
	2
175440	*Sum* 12 *Pence.*
8772	

12) 1052640 (87720

96

92
84

86 *facit* 87720 *pieces of* 6*d.*—4*d.*—2*d.*
84

24
24

(0)

So that I conclude by the Operation, that 87720 six Pences, and 87720 Groats, and 87720 two Pences are just as much as (or equal to) 4386 *l.* or if you admit of 5 *s.* to be thus divided, it is equal to 5 six Pences, and 5 four Pences or Groats, and 5 two Pences. *For if two right Lines (or two Numbers) be given, and one of them be divided into as many Parts, or Segments as you please, the Rectangle (or Product) comprehended under the two whole right Lines (or Numbers given) shall be equal to all the Rectangles (or Products) contained under the whole Line, (or Number,) and the several Segments (or Parts) into which the other Line (or Number) is divided,* Eucl. 2. 1.

Another Question of the same Nature with the last, may be this following, *viz.*

Quest 12. A Merchant is desirous to change 148 *l.* into pieces of 13 *d* $\frac{1}{2}$, of 12 *d.* of 9 *d.* of 6 *d.* and of 4 *d.* and he will have of each sort an equal Number of pieces, I desire to know the Number?

Do as you were taught in the last Question, *viz.* add the several pieces together, and reduce the summ into half-pence, then reduce the summ to be changed, *viz.* 148 *l.* into the same denomination, and divide the greater by the lesser, and in the Quotient you will find the Answer, *viz.* 798 is the Num-

ber of each of the pieces required, and 18 remaineth, which is 18 half pence, by the eighth Rule of this Chapter. See the Work as followeth.

l.		*d.*
148		$13\frac{1}{2}$
240	*pence in a Pound.*	12
		9
5920		6
296		4
35520	*Pence in* 148 *l. summ*	44
2		$2\frac{1}{2}$
71040	*half-pence*	89 *half-pence.*

89) 71040 (798 *pieces of each sort.*
623

874
801

730
712

Remains (18) *half pence.*

The truth of the two foregoing Operations will thus be proved, *viz.* multiply the Answer by the parts, or pieces into which the given Number was reduced; and having

ving added the ſeveral Products together if their ſumm be equal to the given Number, the Anſwer is right, otherwiſe not.

So the Anſwer to the 11 Queſtion was 87720, which is proved as followeth, *viz.*

		l.
87720	*Six Pences make*	2193
	Four Pences make	1462
	Two Pences make	731

The Total ſumm of them 4386 *which was the ſumm given to be changed.*

The Anſwer to the 12 Queſtion was 798, and 18 half-pence remained after the Work was ended; now the Truth of the Work may be proved as the former was, *viz.*

	d.	*l.*	*s.*	*d.*
798	*Piece of* $13\frac{1}{2}$ *make*	44	17	09
	Pieces of 12 *make*	39	18	00
	Pieces of 9 *make*	29	18	06
	Pieces of 6 *make*	19	19	00
	Pieces of 4 *make*	13	06	00
	and 18 *half-pence, or* 9 d. *rem.*	00	00	09
	The total Summ of them	148	00	00

which

which Total Summ is equal to the Number that was first given to be changed, and therefore the Operation was rightly performed.

Reduction of Troy Weight.

We come now to give the Learner some Examples in Troy Weight, wherein we shall be brief, having given so large a Taste of *Reduction* in the foregoing Examples of Coyn, and now the Learner must be mindful of the Table of Troy Weight delivered in the second Chapter of this Book.

Quest. 13. In 482 *l.* 07 *oz.* 13 *p. w.* 21 *gr.* how many Grains?

Multiply by 12, by 20, and by 24, taking in the Figures standing in the several denominations, according to the Direction given in the 7th Rule of this Chapter, and you will find the Product to be 2780013 Grains, which is the Number required, or Answer to the Question. See the whole Work as followeth.

l. *oz.* *p.w.* *gr.*
482—07—13—21
12

9 7 1
4 8 2

5791 *Ounces.*
20

115833 *Penny Weight.*
24

463333
231668

Facit 2780013 *Grains.*

Quest. 4. In 2780013 Grains, I demand how many Pounds, Ounces, Penny Weights, and Grains?

This is but the foregoing Question inverted, and is resolved by dividing by 24, by 20, and by 12, and the Answer is 482 *l.* 07 *oz.* 13 *p.w.* 21 *gr.*

24)

```
                    2|0)          12)         l.
24)2780013       (11583|3      (5791       (482
   ......          ....          ...

   24               10           48
   --              ----         ----
   38               15           99
   24               14           96
  ----             ----         ----
   140              18           31
   128              18           24
  ----             ----         ----
    200               3 Rem. (7) Ounces.
    192               2
   ----            ----
      81 Rem. (13) Penny Weight.
      72
   ----
      93                  l.     oz.    p.w.    gr.
      72          Facit 482 —— 07 —— 13 —— 21
   ----
Remains (21) Grains.
```

Quest. 15. A Merchant ſent to a Goldſmith 16 Ingots of Silver, each containing in Weight 2 *l.* 4 *oz.* and ordered it to be made into Bowls of 2 *l.* 8 *oz. per* Bowl, and Tankards of 1 *l.* 6 *oz. per* Piece, and Salts of 10 *oz.* 10 *p.w. per* Salt, and Spoons of 1 *oz.* 18 *p.w. per* Spoon; and of each an equal Number, I deſire to know how many of each ſort he muſt make?

This Queſtion is of the ſame Nature with the 11 and 12 Queſtions foregoing, and may be

be anſwered after the ſame Method, *viz.* Firſt, add the Weight of the ſeveral Veſſels (into which the Silver is to be made) into one ſumm, and reduce it to one denomination, and they make 1248 Penny Weights, then reduce the Weight of the Ingot into the ſame denomination, *viz.* Penny Weights, (and it makes 560 Penny Weights) and multiply them by the Number of Ingots, *viz.* 16, and the Product will give you the Weight of the 16 Ingots, *viz.* 8960, then divide this Product by the Weight of the Veſſels, *viz.* 1248, and the Quotient giveth you the Anſwer to the Queſtion, *viz.* 7. and 224 *p.w.* remaining over and above.

l. — *oz.*
2——4
12
——
28
20
——
560 *Penny Weights.*
16 *Ingots.*
——
3360
560
——
1248) 8960 (7 *Veſſels of each.*
8736
——
Rem. (224) *Penny Weights.*

l. — *oz.* — *p.w.*
2----08----00
1----06----00
0----10----10
0----01----18
——
Summ 5----02----08
12
——
62
20
——
1248 *P. weights.*

The

The Proof of the Work is as followeth, viz.

		l.	oz.	p.w.
7.	*Bowls of* 2---08---00 *per Bowl.* is	18	08	00
	Tank of 1---06---00 *per Tank.* is	10	06	00
	Salts of 0---10---10 *per Salt* is	06	01	10
	Spoons of 0---01---18 *per Spoon* is	00	01	06
	224 *Penny Weight remaining* is	00	11	04
	Total Summ	37	04	00

So that you ſee the ſumm of the Weights of each Veſſel, together with the Remainder is 37*l.* 04 *oz.* which is equal to the Weight of the 16 Ingots delivered. For if 37*l.* 04 *oz.* be reduced to Penny Weights, it makes 8960.

Reduction of Averdupois Weight.

In reducing Averdupois Weight, the Learner muſt have recourſe to the Table of Averdupois Weight delivered in the 2*d.* Chapter foregoing.

Queſt. 16. In 47 *C.* 1 *qr.* 20 *l.* how many Ounces?

Multiply by 4, by 28, and by 16, and the laſt Product will be the Anſwer, *viz.* 84992 Ounces.

C.	*qrs.*	*l.*
47 —	1 —	20

4

199 *Quarters.*
28

1512
380

5312 *l.*
16

31872
5312

Facit 84992 *Ounces.*

Quest. 17. In 84992 Ounces, I demand how may *C. qrs. l.* and *oz.*

This is the foregoing Question Inverted, and will be resolved if you divide by 16, by 28, and by 4, and the Answer is 47 *C.* 1 *qrs.* 20 *l.* equal to the given Number in the foregoing Question.

16)

```
               28)     4)    C. qrs. l. oz.
  16)84992   (5312   (189  (47 -1--20 00
     ....      ...
     80        28      16
     --        --      --
      49       251     29
      48       224     28
      --       ---     --
       19      172    (1) Quarter.
       16      252
       --      ---
        32    (20) Pounds.
        32
        --
       (0)
```

Quest. 18. A Chapman buyeth of a Grocer 4 *C.* 1 *qrs.* 14 *l.* of Pepper, and ordered it to be made up into Parcels of 14 *l.* of 12 *l.* of 8 *l.* of 6 *l.* and of 2 *l.* and of each Parcel an equal Number; now I would know the Number of each Parcel.

This Example is of the same Nature with the 11, and 12, and 15 Questions foregoing, and after the same manner is resolved. See the Operation as followeth.

C.	*qrs.*	*l.*	*l.*
4	1	14	14

```
 C.   qrs.   l.            l.
 4 ——— 1 ——— 14            14
 4                         12
———                         8
 17                         6
 28                         2
———                       ———
140                        42 Pounds.
 35
———
42) 490 (11
    ..
    42
   ———
     70 Facit 11 Parcels of each.
     42
    ———
Rem. (28) Pounds.
```

Reduction of Liquid Measures.

Quest. 19. In 45 Tun of Wine, how many Gallons?

Multiply by 4, and by 63, the Product is 11340 Gallons for the Answer.

```
  45
   4
 ———
 180
  63
 ———
 540
1080
————
```

Facit 11340 *Gallons.*

Quest. 20.

Quest. 20. In 34 Rundlets of Wine, each containing 18 Gallons, I demand how many Hogsheads?

First, Find how many Gallons is in the 43 Rundlets, which you may do if you multiply 43 by 18, the content of a Rundlet, and the Product is 612 Gallons, which you may reduce into Hogsheads if you divide them by 63, and the Quote will be 9 Hogsheads, and 45 Gallons. See the Work.

```
      34
      18
     ----
     272
     34
     ----
63) 612 (9 Hhds.
    567
    ----
```

Remains (54) *Gallons.*

Facit 9 *Hhds.* 45 *Gallons.*

Quest. 21. In 12 Tun, how many Rundlets of 14 Gallons *per* Rundlet?

Reduce your Tuns into Gallons, and divide them by 14, the Gallons in a Rundlet, and the Quotient (216) is your Answer. See the Work following.

12

```
      12
       4
    ----
      48
      63
    ----
     144
    288
    ----
14) 3024 (216 Rund.
    ...
    28
    ----
     22
     14
    ----
     84
     84
    ----
     (0) Facit 216 Rundl.
```

Reduction of Long Measure.

Quest. 22. I demand how many Furlongs, Poles, Inches, and Barley Corns will reach from *London* to *York*, it being accounted 151 Miles?

151	*Miles.*
8	*Furlongs in a Mile.*
1208	*Furlongs.*
40	*Poles in a Furlong.*
48320	*Poles.*
11	*half Yards in a Pole.*
48320	
48320	
531520	*Half-Yards.*
18	*Inches in half a Yard.*
4252160	
531520	
9567360	*Inches.*
3	*Barly Corns in an Inch.*
Facit 28702080	*BalyCorns in* 151 *Miles.*

Quest. 23. The Circumference of the Earth (as all other Circles are) is divided into 360 Degrees, and each Degree into 60 Minutes, which (upon the Superficies of the Earth) are equal to 60 Miles; now I demand how many Miles, Furlongs, Perches, Yards, Feet, and Barly Corns will reach round the Globe of the Earth?

360 *Degrees.*
60 *Minutes or Miles in a Degree.*

21600 *Miles about the Earth.*
8 *Furlongs in a Mile.*

172800 *Furlongs about the Earth.*
40 *Perches in a Furlong.*

6912000 *Poles or Perches about the Earth*
11 *Half-yards in a Perch.*

6912000
6912000

2) 76032000 *Half-yards about the Earth.*

38016000 *Yards, viz. the Half-yards.*
3 *divided by* 2.

114048000 *Feet about the Earth.*
12 *Inches in a Foot.*

228096000
114048000

1368576000 *Inches about the Earth.*
3 *Barley-Corns in an Inch.*

4105728088 *Barly-Corns.*

And ſo many will reach round the World, the whole being 21600 Miles; ſo that if any Perſon were to go round, and go 15 Miles every Day, he would go the whole Circumference in 1440 Days, which is 3 Years, 11 Months, and 15 Days.

Reduction

Reduction of Time.

Quest. 24. In 28 Years, 24 Weeks, 4 Days 16 Hours, 30 Minutes, how many Minutes?

Years.	*Weeks.*	*Days.*	*Hours.*	*Min.*
28	24	4	16	30

```
   28
   52  Weeks in a Year.
  ----
   60
  14
 -----
 1480  Weeks.
    7
 -----
10364  Days.
   24
 ------
 41462
20729
-------
248752  Hours.
    60
14925150  Minutes.
```

Note, that in resolving the last Question after the Method expressed, there is lost in every Year 30 Hours, for the Year consisteth of 365 Days and 6 Hours, but by multiplying the Years by 52 Weeks, which is but 364 Days, you lose 1 Day and 6 Hours every Year; wherefore to find an exact Answer, bring the odd Weeks, Days, and Hours into Hours, and then multiply the

Years

Years by the Number of Hours in a Year, *viz.* 8766, and to the Product add the Hours contained in the odd time, and you ave the exact time in Hours, which bring nto Minutes as before. See the last Que-tion thus resolved.

		weeks days hours
		24—4—16
		7
	days hours	172
28	365—6	24
8766	24	694
172	1466	345
172	730	4144 *hours.*
197	8766 *hours in a year.*	
228		
249592 *hours.*		
60		
14975520 *minutes in* 28 *years and* 4144 *hours.*		

So you see that according to the Method rst used to resolve this Question, the Hours ontained in the given time are 248752, but ccording to the last, best, or true Method, hey are 249592, which exceeds the former y 840 Hours.

But for most occasions it will be sufficient o multiply the given Years by 365, and to he Product add the days in the odd time, if

there be any, and then there will be only a loss of six Hours in every Year, which may be supplied by taking a fourth part of the given Years, and adding it to the contained Days, and you have your desire.

Quest. 25. In 438657540 Minutes, how many Years? *Facit* 834 *Years*, 4 *Days*, 19 *Hours*.

```
                      8766)     Years   Days   Hours.
6|0) 43865754|0  (7310959  (834———4———19
       42           70128
       ——           —————
       18           29815
       18           26298
       ——           —————
        6           35179
        6           35064
       ——           —————Days
       57      24)  115 (4
       54            96
       ——           ——
       35   Rem.   (19) Hours.
       30
       ———
       54
       54
       ——
       (0)
```

Quest. 26. I desire to know how many Hours and Minutes it is since the Birth of our Saviour Jesus Christ, to this present Year, being accounted 1677 Years?

This

This Question is of the same Nature with the 24th foregoing, and after the same manner is resolved, *viz.* Multiply the given Number of Years by 8766, the Product is 14700582 Hours, and that by 60, and the Product is 882034920 Minutes. See the Work.

```
      1677 Years.
      8766 Hours in a Year.
     ------
     10062
    10062
   11739
  13416
  --------
  14700582 Hours in 1677 Years.
        60
  --------
 882034920 Minutes in 1677 Years.
```

Note that as Multiplication and Division do interchangeably prove each other, so Reduction descending, and ascending, prove each other by inverting the Question, as the 13 and 14, and likewise the 16 and 17 Questions foregoing, by Inversion, do interchangeably prove each other, the like may be performed for the proof of any Question in Reduction whatsoever.

Thus far have we discoursed concerning single Arithmetick, whose Nature and Parts are defined in the second, eighth, ninth, and tenth definitions of the third Chapter of this Book; for although Reduction is not reckoned or defined among the Parts of single Arithmetick, yet considered abstractly, it is the proper effect of Multiplication and Division; and as for the Extraction of Roots (which ought to be handled in the next place as parts of single Arithmetick) we shall omit it in this place, and refer the Learner to Mr. *Cocker*'s decimal Arithmetick, which is (with great Care and Pains) now published, together with his Logarithmetical Arithmetick, shewing the Genesis or Fabrick of the Logarithms, and their general uses in Arithmetick, *&c.* As also his Algebraical Arithmetick, containing the Doctrine of composing and resolving an Equation, with all other Rules necessary for the understanding of that mysterious Art, *&c.*

CHA

CHAP. IX.

Of Comparative Arithmetick, viz. The Relation of Numbers one to another.

1. COmparative Arithmetick is that which is wrought by Numbers, as they are considered to have relation one to another; and this consists either in Quantity, or in Quality.

Boetius Arith. lib. 1. cap. 21.

2. Relation of Numbers in Quantity, is the reference or respect, that the Numbers themselves have one to another, where the Terms or Numbers propounded are always two, the first called the Antecedent, and the other the Consequent.

Wide Wing. Arith. cap. 34.

3. The Relation of Numbers in Quantity, consists in the Differences, or in the Rate or Reason that is found betwixt the Terms propounded, the difference of two

Numbers, being the remainder found by Substraction, but the Rate or Reason betwixt two Numbers is the Quotient of the Antecedent divided by the Consequent. So 21 and 7 being given, the difference betwixt them will be found to be 14, but the Rate or Reason that is betwixt 21 and 7 will be found to be Triple Reason, for 21 divided by 7 quotes 3, the Reason or Rate.

Alsted. Mathemat. lib. 2. cap. 11, & 12.

4. The Relation of Numbers in Quality, (otherwise called Proportion,) is the reference or respect that the Reason of Numbers have one unto another; therefore the Terms given, ought to be more than 2. Now this Proportion or Reason between Numbers relating one to another, is either Arithmetical or Geometrical.

Alsted. Math. lib. 2. cap. 21.

5. Arithmetical Proportion (by some called Progression) is when divers Numbers differ one from another by equal Reason, that is, have equal Differences.

So this rank of Numbers, 3, 5, 7, 9, 11, 13, 15, 17, differ by equal Reason, *viz.* by 2, as you may prove.

6. In a Rank of Numbers that differ by Arithmetical Proportion, the summ of the first and last Term, being multiplied by half the Number of Terms, the Product is the Total summ of all the Terms. Or

Or if you multiply the Number of the Terms by the half summ of the first and last Terms, the Product thereof will be the Total summ of all the Terms.

So in the former Progression given, 3 and 17 is 20, which multiplied by 4 (*viz.* half the Number of Terms) the Product gives 80, The summ of all the Terms; or multiply 8, (the Number of Terms) by 10 half the summ of the first and last Terms) the Product gives 80 as before.

So also 21, 18, 15, 12, 9, 6, 3, being given, the summ of all the Terms will be found to be 84; for here the Number of Terms is 7, and the summ of the first and last (*viz.* 21 and 3) is 24, half whereof (*viz.* 12) multiplied by 7 produceth 84, the summ of the Terms sought.

7. Three Numbers that differ by Arithmetical Proportion, the double of the mean (or middle Number) is equal to the summ of the Extreams.

So 9, 12, and 15, being given the double of the mean 12 (*viz.* 24.) is equal to the summ of the Extreams, 9 and 15.

8. Four Numbers that differ by Arithmetical Proportion (either continued or interrupted) the summ of the two Means is equal to the summ of the two Extreams.

Vide Wing. Arithm. cap. 35.

So 9, 12, 18, 21, being given, the summ of 12 and 18 ~~will~~ be equal to the summ of 9 and 21, *viz.* 30; also 6, 8, 14, 16, being given, the summ of 8 and 14, is equal to the summ of 6 and 16, *viz.* 22, *&c.*

9. Geometrical Proportion (by some called Geometrical Progression) is when divers Numbers differ according to right Reason.

So 1, 2, 4, 8, 16, 32, 64, *&c.* differ by double Reason, and 3, 9, 27, 81, 243, 729, differ by Triple Reason, 4, 16, 64, 256, *&c.* differ by Quadruple Reason, *&c.*

10. In any Numbers that increase by Geometrical Proportion, if you multiply the last Term by the Quotient of any one of the Terms, divided by another of the Terms, which being less is next unto it, and having deducted, or substracted, the first Term out of that Product, divide the remainder by a Number that is an Unit less than the said Quotient, the last quote will give you the summ of all the Terms.

64
4) 8 2
128
1
1) 127 (127

So 1, 2, 4, 8, 16, 32, 64, being given, first, I take one of the Terms, *viz.* 8, and divide it by the Term, which is less and next to it, (*viz.* by 4,) and the Quotient is 2, by

by which I multiply the laſt Term 64, and the Product is 128, from whence I ſubſtract the firſt Term (*viz.* 1.) the remainder is 127, which divided by the Quotient 2 made leſs by 1 (*viz.* 1.) the quote is 127, for the ſumm of all the given Terms, as by the Work in the Margent.

So if 4, 16, 64, 256, 1024 were given, the ſumm of all the Terms will be found to be 1364. For firſt, I divide 64 one of the Terms by his next leſſer Term, and the Quotient is 4, by which I multiply the laſt Term 1024, and it produceth 4096; from whence I ſubſtract the firſt Term 4, and the remainder is 4092, which I divide by the quote leſs one (*viz.* 3) and the quote is 1364, for the Total ſumm of all the Terms, as *per* Margent.

```
        1024
16)64(    4
    -------
        4096
           4
    -------
3) 4092 (1364
```

So likewiſe if 2, 6, 18, 54, 162, 486, were given, the Summ or Total of all the Terms will be found to be 728. See the Work.

```
        486
6) 18(    3
    -------
       1458
          2
2) 1456 (728
```

11. Three Geometrical Proportionals given, the Square of the Mean is

equal to the Rectangle, or Product of the Extreams.

So 8, 16, 32, being given, the Square of the Mean, *viz.* 16, is 256, which is equal to the Product of the Extreams 8 and 32, for 8 times 32 is equal to 256.

12. Of 4 Geometrical proportional Numbers given, the Product of the two Means is equal to the Product of the two Extreams.

So 8, 16, 32, 64, being given, I say that the Product of the two Means, *viz.* 16 times 32 which is 512 is equal to 8 times 64, the Product of the Extreams.

Alſo if 3, 9, 21, 69, were given, (which are interrupted,) I ſay 9 times 21 is equal to 3 times 63, which is equal to 189.

Fron hence ariſeth that precious Gem in Arithmetick, which for the Excellency thereof is called the Golden Rule, or Rule of Three.

CHAP. X.

The Single Rule of Three Direct.

THE Rule of Three (not undeſervedly called the Golden Rule) is, that by which we find out a fourth Number, in proportion unto three given Numbers, ſo as

as this fourth Number sought, may bear the same Rate, Reason, or Proportion to the *third* (given) Number, as the second doth to the first, from whence it is also called the Rule of Proportion.

2. Four Numbers are said to be proportional, when the first containeth or is contained by the second, as often as the third containeth, or is contained by the fourth. *Vide Wingate*'s *Arith. Chap*. 8. *Sect*. 4.

So these Numbers are said to be Proportionals, *viz*. 3, 6, 9, 18, for as often as the first Number is contained in the second, so often is the third contained in the fourth, *viz*. twice. Also 9, 3, 15, 5, are said to be proportional; for as often as the first Number containeth the second, so often the third Number containeth the fourth, *viz*. 3 times.

3. The Rule of Three is either simple, or composed.

4. The simple (or single) Rule of Three, consisteth of four Numbers, that is to say, it hath three Numbers given to find out a fourth; and this is either Direct, or Inverse. *Vide Alsted. Math. lib*. 2. *Cap*. 13.

5. The single Rule of Three direct, is when the Proportion of the first Term is to the second, as the third is to the fourth; or when it is required that the Number sought (*viz*. the fourth Number) must have the same proportion

portion to the second, as the third hath to the first.

6. In the Rule of Three, the greatest difficulty is (after the Question is propounded) to discover the Order of the three Terms, *viz.* which is the first, which is the second, and which is the third, which that you may understand, observe, That (of the three given Numbers) two are always of one kind, and the other is of the same kind with the proportional Number that is sought; as in this Question, *viz.* If 4 Yards of Cloth cost 12 Shillings, what will 6 Yards cost at that Rate? Here the two Numbers of one kind are 4 and 6, *viz.* they both signifie so many Yards; and 12 Shillings is the same kind with the Number sought, for the price of 6 Yards is sought.

Again, observe, that of the 3 given Numbers, those two that are of the same kind, one of them must be the first, and the other the third, and that which is of the same kind with the Number sought, must be the second Number in the Rule of Three; and that you may know which of the said numbers to make your first, and which your third, know this: That to one of those two Numbers there is always affixed a demand, and that Number upon which the demand lieth must always be reckoned the third Number. As in the forementioned

mentioned Queſtion, the demand is affixed to the Number 6; for it is demanded what 6 Yards will coſt? And therefore 6 muſt be the third Number, and 4 (which is of the ſame denomination (or kind) with it) muſt be the firſt, and conſequently the Number 12, muſt be the ſecond, and then the Numbers being plac'd in the foremen-tioned order will ſtand as followeth, *viz.*

Yards.	*s.*	*Yards.*
4	12	7

7. In the Rule of *Three Direct* (having placed the Number as is before directed, the next thing to be done will be to find out the fourth Number in proportioin, which (that you may do) multiply the ſecond Number by the third, and divide the Product thereof by the firſt: Or, (which is all one multiply the third Term (or Number) by the ſecond, and divide the Product thereof by the firſt, and the Quotient thence ariſing is the fourth Number in a direct proportion, and is the Number ſought, or Anſwer to the Queſtion, and is of the ſame denomination that the ſecond Number is of. As thus, let the ſame Queſtion be again repeated, *viz.* If 4 Yards of Cloth coſt 12 Shillings, what will 6 Yards coſt?

Having

Having placed my Numbers according to the *6th* Rule (of this Chapter) foregoing, I multiply (the second Number) 12, by (the third Number) 6, and the Product is 72, which Product I divide by (the first Number) 4, and the Quotient thence arising is 18, which is the fourth Proportional or Number sought, *viz.* 18 Shillings, (because the second Number is Shillings) which is the Price of the 6 Yards, as was required by the Question. See the Work following.

	yds.		*s.*		*yds.*		*s.*
If	4	—	12	—	6	—	18

```
         6
        ---
    4) 72 ( 18 Shillings.
        4
       ---
       32
       32
       ---
       (0)
```

Quest. 2. Another Question may be this, *viz.* If 7 *C.* of Pepper cost 21 *l.* how much will 16 *C.* cost at that rate ?

To resolve which Question, I consider that (according to the 6 Rule of this Chapter)

ter) the Terms or Numbers ought to be placed thus, *viz.* the Demand lying upon 16 *C.* it must be the third Number, and that of the same kind with it must be the first, *viz.* 7. *C.* and 21 *l.* (being of the same kind with the Number sought) must be the second Number in this Question; then I proceed according to this 7*th.* Rule, and multiply the second Number by the third, *viz.* 21 by 16, and the Product is 336, which I divide by the first Number 7, and the Quotient is 48 *l.* which is the Value of 16 *C.* of Pepper at the rate of 21 *l.* for 7 *C.* See the Work as followeth.

```
     C:   l.   C:
If   7 — 21 — 16
          16
         ----
         126
          21
         ----      l.
      7) 336 (48
          ..
          28
         ----
          56
          56  Facit 48 l.
         ----
          00
```

8. If

8. If when you have divided the Product of the second and third Numbers by the first, any thing Remain after Division is ended, such Remainder may be multiplied by the parts of the next inferiour denomination, that are equal to an Unit (or Integer) of the second Number in the Question, and the Product thereof divide by the first Number in the Question, and the Quotient is of the same denomination with the Parts by which you multiplied the Remainder, and is part of the fourth Number which is sought. And farthermore, if any thing remain, after this last Division is ended, multiply it by Parts of the next inferior denomination equal to an Unit of the last Quotient, and divide the Product by the same Divisor (*viz.* the first Number in the Question) and the Quote is still of the same denomination with your Multiplier; follow this method until you have reduced your Remainder into the lowest denomination, *&c.* An Example or two will make the Rule very plain, which may be this following.

Quest. 3. If 13 Yards of Velvet (or any other thing) cost 21 *l.* what will 27 Yards of the same cost at that rate?

Having ordered and wrought my Numbers according to the 6 and 7 Rules of this Chapter,

Chapter, I find the Quotient to be 43 *l.* and there is a Remainder of 8; ſo that I conclude the Price of 27 Yards to be more than 43*l.* and to the intent that I may know how much more, I work according to the foregoing Rule, *viz.* I multiply the ſame Remainder 8, by 20 *s.* (becauſe the ſecond Number in the Queſtion was Pounds) and the Product is 160. which divided by the firſt Number, *viz.* 13, it quotes 12, which are 12 Shillings, and there is yet a Remainder of 4, which I multiply by 12 Pence, (becauſe the laſt Quotient was Shillings,) and the Product is 48, which I divide by 13, (the firſt Number,) and the Quotient is 3*d.* and yet there remaineth 9, which I multiply by 4 Farthings, and the Product is 36; which divided by 13 again, it quotes 2 Farthings, and there is yet a Remainder of 10, which (becauſe it cometh not to the Value of a Farthing) may be neglected, or rather ſet (after the 2 Farthings) over the Diviſor, with a Line between them, and then (by the 21 and 22 Definitions of the firſt Chapter of this Book) it will be $\frac{10}{13}$ of a Farthing: So that I conclude, that if 13 Yards of Velvet coſt 21 *l.* 27 Yards of the ſame will coſt 43*l.* 12*s.* 3 *d.* 2$\frac{10}{13}$ *qrs.* which Fraction is 10 thirteenths of a Farthing. See the Operation as followeth.

If

```
     yds.   l.   yds.
If   13 — 21 — 27
            27
         ------
           149
           42
        ------
    13) 567 (43 l.
         ..
          52
        ------
           47
           39
        ------
Remains   (8)
Multiply  20
        ------
    13) 160 (12 s.
         ..
          13
        ------
           30
           26
Remains   (4)
        ------
Multiply  12
    13)  48 (3 d.
         39
Remains   (9)
Multiply   4
        ——qrs.
    13)  36 (2 10/11
         26
        ------               l.    s.   d.  qrs.
Remains  10     Facit   43 -- 12 — 3 -- 2 10/11
                                          Quest.
```

Quest. 4. Another Example may be this following, *viz.* If 14 *l.* of Tabacco cost 27 *s.* what will 478 *l.* cost at that rate?

Work according to the last Rule, and you will find it to amount to 921 *s.* 10 *d.* 1 $\frac{2}{14}$ *qrs.* and by the 5*th.* Rule of the 8*th.* Chapter 921 *s.* may be reduced to 46 *l.* 01 *s.* So that then the whole Worth or Value of the 478 *l.* will be 46 *l.* 10 *s.* 10 *d.* 1 $\frac{2}{14}$ *qrs.* the whole Work followeth.

If

```
    yds.    l.    yds.
If  13 —— 21 —— 27
              27
            -----
             149
             42
            -----
       13) 567 (43 l.
            ..
             52
            -----
              47
              39
            -----
Remains      (8)
Multiply      20
            -----
       13) 160 (12 s.
            ..
             13
            -----
              30
              26
Remains      (4)
            -----
Multiply      12
       13)   48 (3 d.
              39
Remains      (9)
Multiply      4
            ——qrs.
       13)   36 (2 10/13
              26
            -----            l.     s.    d.  qrs.
Remains      10    Facit 43 -- 12 -- 3 -- 2 10/13
```

Quest.

Quest. 4. Another Example may be this following, *viz.* If 14 *l.* of Tabacco cost 27 *s.* what will 478 *l.* cost at that rate?

Work according to the last Rule, and you will find it to amount to 921 *s.* 10 *d.* 1 $\frac{2}{14}$ *qrs.* and by the 5*th.* Rule of the 8 *th.* Chapter 921 *s.* may be reduced to 46 *l.* 01 *s.* So that then the whole Worth or Value of the 478 *l.* will be 46 *l.* 10 *s.* 10 *d.* 1 $\frac{2}{14}$ *qrs.* the whole Work followeth.

If

	l.	s.	d.
If	14	27	478

```
                 27
            ---------
               3346
               956
            ---------
         14) 12906 (921
               126
            ---------
                30
                28
            ---------
2|0) 92|1 (46       26
       8            14
    ------       -------
      12   Remains (12)
      12   Multiply 12
    ------       -------
      01            24
                    12
                 -------
              14) 144 (10
                  14
                 -------
            Remains 4
            Multiply 4
          -------          qrs.
              14) 16 ( 1 2/14
                  14
                 -------
             Rem. (2)
```

	l.	s.	d.	qrs.
Facit	46	01	10	$1\frac{2}{14}$

9. In the Rule of Three, it many times happeneth, that although the firſt and third Numbers be Homogeneal, (that is of one kind,) as both Money, Weight, Meaſure, *&c.* yet they may not be of one denomination, or perhaps they may both conſiſt of many denominations, in which caſe you are to reduce both Numbers to one denomination; and likewiſe your ſecond Number (if it conſiſteth (at any time) of divers denominations) muſt be reduced to the leaſt name mentioned, or lower if you pleaſe; which being done, multiply the ſecond and third together, and divide by the firſt, as is directed in the 7*th*. Rule of this Chapter.

And note that always the Anſwer to the Queſtion is in the ſame denomination that your ſecond Number is of, or reduced to, as was hinted before.

Queſt. 5. If 15 Ounces of Silver be worth 3 *l.* 15 *s.* what 86 Ounces worth at that rate?

In this Queſtion the Numbers being ordered according to the 6*th*. Rule of this Chapter, the firſt and third Numbers are Ounces, and the ſecond Number is of divers denominations, *viz.* 3 *l.* 15 *s.* which muſt be reduced to Shillings, and the Shilling multiplied by the third Number, and the Product divided by the firſt, gives you the

the Anſwer in Shillings, *viz.* 430 *s.* which are reduced to 21 *l.* 10 *s.* See the Work.

oz. l. s. oz.
If 15—3—15—86
20
———
75
86
———
458
600
——— 2|0) *l.* *s.*
15) 6450 (43|0 21–10
60 4
——— ———
45 3
45 2
——— ———
00 (10) *Shillings.*

In Reſolving the laſt Queſtion, the Work would have been the ſame, if you had reduced your ſecond Number into Pence, for then the Anſwer would have been 5160 Pence, equal to 21 *l.* 10 *s.* or if you had reduced the ſecond Number into Farthings, the Quotient or Anſwer, would have been 20640 Farthings equal to the ſame as you may prove at your leiſure.

Queſt. 6. If 8 *l.* of Pepper coſt 4 *s.* 8 *d.* what will 7 *C.* 3 *qrs.* 14 *l.* coſt?

In this Queſtion the firſt Number is 8 *l.* and the third is 7 *C.* 3 *qrs.* 14 *l.* which muſt be reduced to the ſame denomination with the

the first, *viz.* into Pounds, and the second Number must be reduced into Pence; then multiply and divide according to the 7*th.* Rule foregoing, and you will find the Answer to be 6174 Pence, which is reduced into 25 *l.* 14 *s.* 6 *d.*

```
 l.   s.  d.              C. qrs.  l.
f8 cost 4--8 what will 7--3--14 cost ?
     12                   4
    ----               ------
     56                  31
                         28
                      -------
                        152
                         63
                       ------
                        882
                         56 Second Number.
                       ------
                       5292
                      4410
                     -------    12)       2|0)  l.
                 8) 49392  (6174     (51|4 (25
                     ....    ...
                     48       60      4
                    ----     ----   ----
                      13       17    11
                       8       12    10
                     ----     ----  ----
                      59       54    14 Shillings.
                      56       48
                     ----     ----
                      32      (6) Pence.
                      32
                     ----              l.   s.   d.
                  (0) Facit  25--14--06
```

Quest. 7. If 3 *C.* 1 *qr.* 14 *l.* of Raisins cost 9 *l.* 9 *s.* what will 6 *C.* 3 *qrs.* 20 *l.* of the same cost? Here

Here the first and third Numbers each consist of divers denominations, but must be brought both into one denomination, &c. as you see in the operation which followeth; the Answer is 388*s.* which is reduced into 19*l.* 8*s.*

```
   C. qrs. l.      l. s.              C. qrs. l.
If 3---1---14 cost 9---9 what will  6---3---20 cost?
   4               20                 4
   ------          ------             ------
   13              189                27
   28                                 28
   ------                             ------
   108                                216
   27                                 56
   ------                             ------
   378 Pounds.                        776 Pounds.
                                      189 second Num.
    6984                             ------
   6208                                    2|0)  l. s.
   776                       378) 146664 (38|8  19--8
   ------                         ....     2
                                 1134     ----
                                 ------    18
                                 3326      18
                                 3024     ----
                                 ------   (08) Shillings
                                  3024
                                  3024           l. s.
                                 ------ facit 19--8
                                   (0)
```

Quest. 8. If in 4 Weeks I spend 13*s.* 4*d.* how long will 53*l.* 06*s.* last me at that rate?

Answer,

Answer, 2238 Days equal to 6 Years, 48 Days. See the Work.

```
 s.  d.          w.                 l.   s.
 13—4 Require 4      what will 53—06 cost ?
 12              7                  20
————            ———               ————
 30             28 Days            1066
 13                                  12
————                              ————
160 Pence                          2132
                                  1066
                                  ————
                                  12792 Pence
                                     28 sec.Num.
                                 —————
                                 102336
                                 25584
                               ————————   395)
                         16|0)35817|6(2238 (69
                              ....      2190
                              32        ————
                            ————Rem.(48)Days
                              38
                              32
                             ———
                              61    Y.  Days.
                              48 fa.6..48 96/100
                             ————
                             137
                             128
                             ————
                     Remains (96)
```

Quest. 9. Suppose the yearly Rent of a House, a yearly Pension, or Wages be 73 *l.* I desire to know how much it is *per* Day?

Here you are to bring the Year into Days, and say, if 365 Days require 73 *l.* what will 1 Day require?

Now when you come to multiply 73 by 1, the Product is the same, for 1 neither multiplieth nor divideth, and 73 cannot be divided by 365, because the Divisor is bigger than the Dividend; wherefore bring the 73 *l.* into Shillings, and they make 1460, which divide by the first Number 365, and the quote is 4 Shillings for the Answer, as you see in the Work.

days. *l.* *day*
If 365—73—1
20

365) 1460 (4 *s.*
1460 *facit* 4 *s. per* Day.

(0)

Quest. 10. A Merchant bought 14 pieces of broad Cloth, each piece containing 28 Yards, for which he gave after the Rate of 13 *s.* $6\frac{1}{2}$ *d. per* Yard, now I desire to know how much he gave for the 14 pieces at that rate?

First,

First, find out how many Yards are in the 14 pieces, which you will do if you multiply the 14 Pieces by 28, (the Number of Yards in a piece,) and it makes 392; then say, If 1 Yard cost 13 *s.* 6½ *d.* what will 392 Yards cost? Work as followeth, and the Answer you will find to be 127400 half-pence, which reduced, make 265 *l.* 8 *s.* 4 *d.* For after you have multiplied your second and third Numbers together, the Product is 127400, which (according to the seventh Rule) should be divided by the first Number; but the first Number is 1, which neither multiplieth, nor divideth, and therefore the Quotient or fourth Number is the same with the Product of the second and third, which is in half-pence, because the second Number was so reduced. See the Work, as followeth.

```
                    28
                    14
                   ----
                   112
                   28
                  -----
                  392 Yards in the 14 pieces.

 yd.   s.  d.            yds.
If 1 cost 13 6½ what will 392 cost ?
        12                325 the second Number.
      -----              -----
        32               1960
        13                784
      -----              1176
       162               ------      2|0)    l.
         2         24) 127400    (530|8  (265
      -----
       325 half-pence  120             4
                        74            13
                        72           ----
                       -----          10
     l.   s.   d.                     10
Facit 265—8—4          200           ----
                       192          (08) shillings.
                       -----
              Rem. (8) ½ pence, or 4 d.
```

Quest. 11. A Draper bought 420 *yds.* of Broad-cloth, and gave for it after the rate 14 *s.* 10¾ *per* Ell *English*; now I demand how much he paid for the whole at that rate?

Bring your Ells into quarters, and your given Yards into quarters, the Ell is 5 quarters,

ters, and in 420 Yards are 1680 quarters; then ſay, if 5 quarters coſt 14 *s.* $10\frac{3}{4}$ *d.* (or 715 Farthings,) what will 1680 quarters coſt? *Facit* 250 *l.* 05 *s.* 00 *d.* See the Operation.

Ell	*Yards*
1	420
5	4
5	1680 *qrs.*

qrs. *s.* *d.* *qrs.*

If 5 — 14 — $10\frac{3}{4}$ — 1680

12 715

28 8400

15 1680

11760

178 *d.* 96|0) *l.*

4 5) 1201200 (24024|0 (250

715 *qrs.* 10 192

l. *s.* *d.* 20 482

Facit 250--05--00 20 480

12 *Rem.*(240) *qrs. or* 5 *s.*

10

20

20

(0)

Queſt. 12. A Draper bought of a Merchant 50 pieces of Kerſeys, each piece containing

taining 34 Ells *Flemish*, (the Ell *Flemish* being 3 quarters of a Yard,) to pay after the rate of 8 *s.* 4 *d.* *per* Ell *English*; I demand how much the 50 pieces cost him at that rate?

First, find out how many Ells *Flemish* are in the 50 pieces, by multiplying 50 by 34, the Product is 1700, which bring into quarters by 3, it makes 5100 quarters; then proceed, as in the last Question, and the Answer you will find to be 102000 Pence, or 425 *l.* Behold the Operation, as followeth.

```
   qrs.  s.   d.        qrs.
If 5 ——— 8 ——— 4 ———— 5100            50
         12            100            54
        ————      ————————          ——————
       100 d.  5) 510000(102000      200
                  ....               150
                                   ——————
              5                   1700 Ells Flem.
           ————                        3
             10                    ——————
             10                   5100 quarters.
           ————
            (0)           2|0)       l.
        12)102000      (850|0    (425
           ..            ..
           96            8
           ——           ———
            60           5
            60           4
           ——           ———
            (0)          10
                         10
       l.               ———
 Facit 425              (0)
```

Quest.

Quest. 13. A Goldſmith bought a Wedge of Gold, which weighed 14 *l.* 3 *oz.* 8 *p.w.* for the ſumm of 514 *l.* 4 *s.* I demand what it ſtood him in *per* Ounce? Anſwer 60 Shillings, or 3 *l.* See the Work.

l. *oz.* *p. w.* *l.* *s.* *oz.*
If 14 —— 3 —— 8 —— 514 —— 4 —— 1
12 20 *Shillings* 20

31 10284 *Shillings* 20 *p. w.*
14 20 *p. w.*
2|0)
171 *oz.* 3428) 205680 (6|0 3 *l.*
20 6
20568 *s.* *l.*
3428 *p. w.* (0) *facit* 60 *or* 3
(0)

Quest. 14. A *Grocer* bought 4 *hhds.* of Sugar, each weighing near 6 *C.* 2 *qrs.* 14 *l.* which coſt him 2 *l.* 8 *s.* 6 *d.* *per C.* I demand the value of the four *hhds.* at that rate?

Firſt, find the weight of the four *hhds.* which you may do by reducing the weight of one of them into Pounds, and multiply them by 4 (the Number of *hhds.*) and they make 2968 *l.* then ſay, If 1 *C.* or 112 *l.* coſt 2 *l.* 8 *s.* 6 *d.* what will 2968 *l.* coſt? *Facit* 64 *l.* 5 *s.* 3 *d.* as by the Operation.

C.	*qrs.*	*l.*
6	2	14

4
———
26
28
———
212
53
———
742 *l. in* 1 *hhd.*
4 *Hogsheads.*
———
2968 *l. in* 4 *hhds.*

l.	*l.*	*s.*	*d.*	*l.*
If 112	2	8	6	2968

20
———
48
12
———
102
48
———
582

582
———
5936
23744
14840
———
112) 1727376 (15423
112
———
607
560
———
473
448
———
257
224
———
336
336
———
(0)

12) (15423 (128|5
12
———
34
24
———
102
96
———
63
60
———
(3) *Pence*

2|0) (128|5 (*l.*
12
———
8
8
———
(05) *Shil.*

	l.	*s.*	*d.*
Facit	64	5	3

Quef

Quest. 15. A Draper bought of a Merchant 8 packs of Cloth, each Pack containing 4 parcels, and each parcel 10 pieces, and in each piece 26 Yards, and gave after the rate of 4 *l.* 16 *s.* for 6 Yards; now I desire to know how much he gave for the whole? Answer, 6656 *l.*

First, Find out how many Yards there were in the 8 packs, as by the following Work you will find there are 8320 Yards; then say, if 6 Yards cost 4 *l.* 16 *s.* what will 8320 Yards cost, *&c.*

8 *Packs.*
4

32 *Parcels.*
10

320 *Pieces.*
26

1920
640

8320 *Yards.*

yds. *l.* *s.* *yds.*
If 6—4—16—8320
20 96

96 49920
74880

2|0) *l.*
6) 798720 (13911|0 (6656

6 12

19 13
18 12

18 11
18 10

07 12
6 12

12 (0)
12

Facit 6656 *l.*

(0)

By this time the Learner is (I suppose) well exercised in the Practick and Theorick of the Rule of 3 Direct, but at his leisure he may look over the following Questions, whose Answers are given, but the Operation purposely omitted as a Touchstone for the Learner, thereby to try his Ability in what hath been delivered in the former Rules.

Quest. 16. If 24 *l.* of Raisins cost 6 *s.* 6 *d.* what will 18 Frails cost, each weighing near 3 *qrs.* 18 *l?* *Answer* 24 *l.* 17 *s.* 03 *d.*

Quest. 17. If an Ounce of Silver be worth 5 Shillings, what is the price of 14 Ingots, each Ingot weighing 7 *l.* 5 *oz.* 10 *p w?* *Answer,* 313 *l.* 05 *s.*

Quest. 18. If a piece of Cloth cost 10 *l.* 16 *s.* 8 *d.* I demand how many Ells *English* there are in the same, when the Ell at that rate is worth 8 *s.* 4 *d.*? *Ans.* 26 Ells *English.*

Quest. 19. A Factor bought 84 pieces of Stuffs, which cost him in all 537 *l.* 12 *s.* at 5 *s.* 4 *d. per* Yard, I demand how many Yards there were in all, and how many Ells *English* were contained in a piece of the same? *Answer* 2016 Yards in all, and $19\frac{1}{5}$ Ells *English per* piece.

Quest. 20. A Draper bought 242 Yards of Broad-cloth, which cost him in all 254 *l.* 10 *s.* for 86 Yards of which he gave after the rate of 21 *s.* 4 *d. per* Yard, I demand

how

how many he gave *per* Yard for the remainder? *Answer*, 20 *s.* 10 $\frac{64}{150}$ *d.* *per* Yard.

Quest. 21. A Factor bought a certain quantity of Serge and Shalloon, which together cost him 226 *l.* 14 *s.* 10 *d.* the quantity of Serge he bought was 48 Yards at 3 *s.* 4 *d.* *per* Yard, and for every 2 Yards of Serge he had 5 Yards of Shalloon, I demand how many Yards of Shalloon he had, and how much the Shalloon cost him *per* Yard? *Answer*, 120 Yards of Shalloon at 1 *l.* 16 *s.* 05 $\frac{58}{120}$ *d.* *per* Yard.

Quest. 22. An Oil-man bought 3 Tun of Oil, which cost him 151 *l.* 34 *s.* and it so chanced that it leaked out 85 Gallons; but he is minded to sell it again, so as that he may be no loser by it, I demand how he must sell it *per* Gallon? *Answ.* at 4 *s.* 6$\frac{174}{671}$ *d.* *per* Gallon.

Quest. 23. Bought 6 packs of Cloth, each pack containing 12 Cloths, which at 8 *s.* 4 *d.* *per* Ell *Flemish* cost 1080 *l.* I demand how many Yards there were in each Cloth? *Answer*, 27 Yards in each Cloth.

Quest. 24. A Gentleman hath 536 *l.* *per Annum*, and his Expences are one Day with another 18 *s.* 10 *d.* 3 *qrs.* I desire to know how much he layeth up at the Year's end? *Answer*, 191 *l.* 03 *s.* 60 *d.* 1 *qr.*

Quest.

Quest. 25. A Gentleman expendeth daily one Day with another 27 *s.* 10$\frac{1}{2}$ *d.* and at the Years end layeth up 340 *l.* I demand how much is his yearly Income? *Answer*, 848 *l.* 14 *s.* 4 *d.* $\frac{1}{2}$.

Quest. 26. If I sell 14 Yards for 10 *l.* 10 *s.* 00 *d.* how many Ells *Flemish* shall I sell for 283 *l.* 17 *s.* 06 *d.* at that rate? *Answer*, 50$\frac{2}{3}$ Ells *Flemish*.

Quest. 27. If 100 *l.* in 12 Months gain 6 *l.* Interest, how much will 75 *l.* gain in the same time, and at the same rate? *Answer* 4 *l.* 10 *s.*

Quest. 28. If 100 *l.* in 12 Months gain 6 *l.* Interest, how much will it gain in 7 Months at that rate? *Answer*, 3 *l.* 10 *s.*

Quest. 29. A certain Usurer put out 75 *l.* for 12 Months, and received Principal and Interest 81 *l.* I demand what rate *per Cent.* he received Interest? *Answer* 8 *l.* *per Cent.*

Quest. 30. A Grocer bought 2 Chests of Sugar, the one weighed neat 17 *C.* 3 *qrs.* 14 *l.* at 2 *l.* 6 *s.* 8 *d.* *per C.* the other weighed neat 18 *C.* 1 *qr.* 21 *l.* at 4$\frac{1}{2}$ *d.* *per l.* which he mingled together, now I desire to know how much a *C.* weight of this mixture is worth? *Answer*, 2 *l.* 4 *s.* 2$\frac{5569}{4067}$ *qrs.*

Quest. 31. Two Men, *viz.* A and B departed both from one place, the one goes East, and the other West, the one travelleth 4 miles

miles a Day, the other 5 miles a Day, how far they are distant the *9th.* Day after their departure? *Answer*, 91 miles.

Quest. 32. *A* flying every Day 40 miles, is pursued the 4th. Day after by *B*, posting 50 miles a Day, now the Question is in how many Days, and after how many miles Travel will *A* be overtaken? *Answer*, *B* overtakes him in 32 Days, when they have Travelled 60 miles.

Moore's Arithm. Chap. 8. Quest. 7.

11. The General Effect of the Rule of Three Direct, is contained in the definition of the same, that is, to find a fourth Number in proportion consisting of two equal Reasons, as hath been fully shewn in all the foregoing Examples.

The second Effect is, by the Price or Value of one thing, to find the Price or Value of many things of like kind.

The third Effect is, by the Price or Value of many things to find the Price of 1, or by the Price of many things (the said Price being 1) to find the Price of many things of the like kind.

The fourth Effect is, by the Price or Value of many things, to find the Price or Value of many things of like kind.

Th

The fifth Effect is, thereby to reduce any Number of Moneys, Weight, or Meaſure, the one ſort into the other, as in the Rules of Reduction contained in the eighth Chapter foregoing. Examples of its various effects have been already Anſwered.

12. The Rule of Three Direct is thus proved, *viz.* Multiply the firſt Number by the fourth, and Note the Product, then multiply the ſecond Number by the third, and if this Product is equal to the Product of the firſt and fourth, then the Work is rightly performed, otherwiſe it is Erroneous.

The Proof of the Rule of Three Direct.

So the firſt Queſtion of this Chapter (whoſe Anſwer, or fourth Number we found to be 18 *s.*) is thus proved, *viz.* the firſt Number is 4, which multiplied by 18 (the fourth) produceth 72. And the ſecond and third Numbers are 12 and 6, which multiplied together produce 72, equal to the Product of the firſt and fourth, and therefore I conclude the Work to be rightly performed.

Always obſerving, that if any thing remain after you have divided the Product of the ſecond and third Numbers by the firſt, ſuch Remainder in proving the ſame, muſt be

be added to the Product of the first and fourth Numbers, whose summ will be equal to the Product of the second and third, (the second Number being of the same denomination with the fourth, and the first with the same denomination of the third.)

So the fourth Question of this Chapter being again repeated, *viz.* If 14 *l.* of Tobaco cost 27 *s.* what will 478 *l.* cost at that rate? The Answer (or fourth Number) was 46 *l.* 01 *s.* 10 *d.* 1 *qr.* $\frac{2}{14}$, which is thus proved, *viz.* bring the fourth Number into Farthings, and it makes 44249 which multiplied by the first Number 14, produceth 619488, (the second which remaineth being added thereto;) then (because I reduced my fourth Number into Farthings) I reduce my second (*viz.* 27 *s.*) into Farthings, and they are 1296, which multiplied by the third Number 478, their Product is 619488, equal to the Product of the first and fourth Numbers. Wherefore I conclude the Operation to be true. This is an infallible way to prove the Rule of Three Direct, and it is deduced from the Twelfth Section of the ninth Chapter of this Book.

Thus much concerning the single Rule of Three Direct, and I question not but by this time the Learner is sufficiently qualified to resolve any Question pertinent to this

Rule,

Rule, not relying upon Fractions, or Geometrical Magnitudes. Those that are desirous to see the demonstration of the Rule, let them read the sixth Capter of (this Ingenious) Mr. *Kersie*'s Appendix to Mr. *Wingate*'s Arithmetick. Or the sixth Chapter of Mr. *Oughthred*'s (Incomparable) *Clavis Mathematica*: By both which Authors this Rule is largely demonstrated, being grounded upon the *19th. Prop.* of the *7th.* and the *19th. Prop.* of the *9th.* of *Euclid. Elem.*

C H A P.

CHAP. XI.

The single Rule of Three Inverse.

1. THE Golden Rule, or Rule of Three Inverse, is when there are 3 Numbers given to find a fourth, in such proportion to the 3 given Numbers, so as the fourth proceeds from the second, according to the same Rate, Reason, or Proportion that the first proceeds from the third : Or the Proportion is,

Alsted. Math. lib. 2. cap. 14.

As the third Number is in proportion to the second, so is the first to the fourth.

So if the third Numbers given were 8, 12, and 16, and it were required to find a fourth Number in an inverted proportion to these, I say that as 16 (the third Number) is the double of the first Term or Number (8,) so must 12 (the second Number) be the double of the fourth; so will you find the fourth Term or Number to be 6. And as in the Rule of Three Direct, you multiply the second and third together, and divide their Product

Product for a fourth Proportional Number: So,

2. In the Rule of Three Inverse, you must multiply the second Term by the first (or first Term by the second) and divide the Product thereof by the first Term; so the Quotient will give you the fourth Term sought in an Inverted Proportion. The same order being observed in this Rule, as in the Rule of Three Direct, for placing and disposing of the given Numbers, and after your Numbers are placed in order, that you may know whether your Question be to be resolved by the Rule Direct or Inverse, observe the general Rule following.

3. When your Question is stated, and your Numbers orderly disposed, Consider in the first place whether the fourth Term or Number sought, ought to be more, or less than the second Term; which you may easily do: And if it is be required to be more, or greater than the second Term, then the lesser Extream must be your Divisor, but if it require less, then the biggest Extream must be your Divisor, (in this Case the first and third Numbers are called Extreams in respect of the second,) and having found out your Divisor, you may know whether your Question belong to the Rule Direct or Inverse; for if the third Term be your Divisor,

visor, then it is Inverse, but if the fir
Term be your Divisor then it is a Dire
Rule. As in the following Questions.

Quest. 1. If 8 Labourers can do a cer
tain Piece of Work in 12 days, in how ma
ny days will 16 Labourers do the same
Answer, in 6 Days.

Having placed the Numbers according t
the 6*th*. Rule of the 10*th*. Chapter, I consider that if 8 Men can finish the Work in 12 Days, 16 Men will do it in lesser (or fewer Days, than 12;) therefore the biggest Extream must be the Divisor, which is 16, and therefore it is the Rule of Three Inverse, wherefore I multiply the first an second Numbers together, *viz.* 8 by 12 an their Product is 96, which divided by 16 quotes 6 Days for the *Answer*, and in so ma ny Days will 16 Labourers perform a Piec of Work, when 8 can do it in 12 Days.

lab.	*days.*	*lab.*
8 —	12 —	16
	8	
	——	
16)	96 (6 *days*	
	96	
	——	
	(0)	
Facit	6	*days.*

Quest. 2. If when the Measure (*viz.*
Peck) of Wheat cost 2 Shillings, the Penn
Loaf weighed (according to the Standar
Statut

tatute; or Law of *England*) 8 Ounces, I emand how much it will weigh when the eck is worth 1 *s.* 6 *d.* according to the me Rate or Proportion? *Answer*, 10 *oz.* 3 *p.w.* 8 *gr.*

Having placed and reduced the given umbers according to the 6 and 9 Rules of e 10*th.* Chapter, I consider that at 1 *s.* *d. per* Peck, the penny Loaf will weigh ore than at 2 *s. per* Peck, for as the price ecreaseth, the weight Increaseth, and as e price Increaseth so the weight Diminish-h; wherefore, because the Term requi-eth more than the second, the lesser Ex-eam must be the Divisor, *viz.* 1 *s.* 6 *d.* r 18 *d.* and having finished the Work, I nd the *Answer* to be 10 *oz.* 13 *p.w.* 8 *gr.* nd so much will the penny Loaf weigh, hen the Peck of Wheat is worth 1 *s.* 6*d.* ccording to the given rate of 8 Ounces, hen the Peck is worth 2 Shillings, the Vork is plain in the following Opera-ation.

2

```
s.         s.    d.
2 ---- 8 ---- 1 ---- 6
12    24     12
--    --     --
24    32     18
      16
     ----  oz. p.w. gr.
18) 192 (10--13--8
     ..
    ----
Rem. (22)
      20
     ---- p.w.
18) 240 (13
     18
    ----
     60
     54
    ----
    (6)
    24
    ---- gr.
18 144 (8
   144
   ----
   (0)
```

Quest. 3. How many pieces of Money or Merchandise at 20 *s. per* piece, are to be given, or received for 240 pieces, the value or price of every piece being 12 Shillings? Answer 144. For if 12 *s.* require 240 pieces, then 20 Shillings will require less; therefore the biggest Extream must be

the Divisor, which is the third Number, &c. See the Work.

s. *pieces* *s.*
If 12—240—20
12
———
480
240
———
2|0) 288|0 (144 *Pieces at* 20*s. per Piece*
2
———
8
8
———
8
8
———
(0)

Quest. 4. How many Yards of 3 quarters broad are required to double, or be equal in measure to 30 Yards, that are five quarters broad? *Answer* 50 Yards. For say, if five quarters wide require 30 Yards long, what length will three quarters broad require? Here I consider that three quarters broad will require more Yards

qrs. *long* *qrs.*
5—30—3
5
———
3) 150(50 *yards*
15
———
(0)

more

more Yards than 30, for the narrower the Cloth is, the more in length will go to make equal meaſure with a broader piece.

Queſt. 5. At the requeſt of a Friend I lent him 200 *l.* for 12 Months, promiſing to do me the like courteſie at my neceſſity, but when I came to requeſt it of him, he could let me have but 150 *l.* now I deſire to know how long I may keep this Money to make plenary ſatisfaction for my former kindneſs to my Friend? *Anſwer*, 16 Months.

I ſay, if 200 *l.* require 12 Months, what will 150 *l.* require? 150 *l.* will require more time than 12 Months, therefore the leſſer Extream (*viz.* 150) muſt be the Diviſor, multiply and divide, and you will find the fourth inverted proportional to be 16, and ſo many Months I ought to keep the 150 *l.* for ſatisfaction.

Queſt. 6. If for 24 *s.* I have 1200 *l.* weight carried 36 Miles, how may Miles ſhall 1800 *l.* be carried for the ſame Money? *Anſwer*, 24 Miles.

Queſt. 7. If for 24 *s.* I have 1200 *l.* carried 36 Miles, how many pound weight ſhall I have carried 24 Miles for the ſame Money? *Anſwer*, 1800 *l.* weight.

Queſt. 8. If 100 Workmen in 12 Days finiſh a Piece of Work or Service, how many Workmen are ſufficient to do the ſame in

in 3 Days? *Answer* 400 Work-men.

Quest. 9. A Colonel is besieged in a Town in which are 1000 Soldiers, with provision of Victuals only for 3 Months, the Question is, how many of his Soldiers must he dismiss, that his Victuals may last the remaining Soldiers 6 Months? *Answer*, 500 he must keep, and dismiss as many.

Quest. 10. If Wine worth 20 *l.* is sufficient for the Ord'nary of 100 Men, when the Tun is sold for 30 *l.* how many Men will the same 20 Pounds worth suffice, when the Tun is worth 24 *l*? *Answer*, 125 Men.

Quest. 11. How much Plush is sufficient to line a Cloak, which hath in it 4 Yards of 7 quarters wide, when the Plush is but 3 quarters wide? *Answer*, $9\frac{1}{3}$ Yards of Plush.

Quest. 12 How many Yards of Canvas that is Ell-wide, will be sufficient to line 20 Yards of Say, that is 3 quarters wide? *Answer*, 12 Yards.

Quest. 13. How many Yards of Matting that is 2 Foot wide, will cover a Floor that is 4 Foot long, and 20 Foot broad? *Answer*, 40 Foot.

Quest. 14. A Regiment of Soldiers consisting of 1000, are to have new Coats, and each Coat to contain 2 Yards, 2 quarters of Cloth, that is 5 quarters wide, and they are to be lined with Shalloon, that is 3 quarters

ters

ters wide, I demand how many Yards of Shalloon will line them? *Answer*, 16666 quarters of Yards, or 4166$\frac{2}{4}$ Yards.

Quest, 15. A Messenger makes a Journey in 24 Days, when the Day is 12 Hours long I desire to know in how many Days he will go the same, when the day is 16 Hours long? *Answer*, in 18 Days.

Quest. 16. Borrowed of my Friend 64 for 8 Months, and he hath occasion another time for to borrow of me for 12 Months I desire to know how much I must lend to make good his former kindness to me? *Answer*, 42 *l*. 13 *s*. 4 *d*.

4. The General Effect of the Rule of Inverse is contained in the definition of the same, that is, to find a fourth Term in reciprocal Proportion, inverted to the Proportion given.

The second Effect, is by two Prices, or values of two several pieces of Money or Merchandise known, to find how many pieces of the one price is to be given for so many of the other. And consequently to Reduce and Exchange one sort of Money, or Merchandise, into another. Or contrariwise to find the price unknown of any piece given to Exchange, in reciprocal Proportion.

The third Effect, is, by two differing prices of a Measure of Wheat bought or sol-

ſold, and the Weight of the Loaf of Bread, made anſwerable to one of the prices of the Meaſure given, to find out the Weight of the ſame Loaf, anſwerable to the other price of the ſaid Meaſure given. Or contrariwiſe by the two ſeveral Weights of the ſame prized Loaf, and the price of the Meaſure of Wheat anſwerable to one of thoſe Weights given, to find out the other price of the Meaſure anſwerable to the other Weight of the ſame Loaf.

The fourth Effect, is, by two lengths, and one breadth of two Rectangular Planes known, to find out another breadth unknown. Or by two breadths and one length given, to find out another length unknown in an inverted Proportion.

The fifth Effect, is, by double time and a Capital ſumm of Money borrowed or lent, to find out another capital ſumm anſwerable to one of the given times; or otherwiſe, by two Capital-ſumms, and a time anſwerable to one of them given, to find out a time anſwerable to the other Capital ſumm in reciprocal Reaſon.

The ſixth Effect, is, by two differing Weights of Carriage, and the diſtance of the places in Miles or in Leagues given, to find another diſtance in Miles anſwerable to the ſame price of payment; or otherwiſe

by two diſtances in Miles, and the Weight anſwerable to one of the Diſtances (being carried for a certain price) to find out the Weight anſwerable to the other diſtance for the ſame price.

The ſeventh Effect is by double Workmen, and the time anſwerable to one of the Numbers of Workmen given, to find out the time anſwerable to the other Number of Workmen, in the performance of any Work or Service. Or contrariwiſe, by double time, and the Workmen anſwerable to one of thoſe times given, to find out the Number of Workmen anſwerable to the other time, in the performance of any Work or Service.

Alſo by a double price of Proviſion, and the Number of Men, or other Creatures nouriſhed for a certain time, anſwerable to one of the prices of Proviſion given, to find out another Number of Men or other Creatures anſwerable to the other price of the Proviſion for the ſame time. Or contrariwiſe by two Numbers of Men or other Creatures nouriſhed, and one price of Proviſion anſwerable to one of the Numbers of Creatures given, to find out the other price of the ſame Proviſion anſwerable to the other Number of Creatures, both being ſuppoſed to be nouriſhed for the ſame, &c. As in the foregoing Examples is fully declared.

To

To prove the Operation of the Rule of 3 Inverſe, multiply the third and fourth Terms together, aud note their Product; and multiply the firſt and ſecond together, and if their Product is equal to the Product of the third and fourth, then is the Work truly wrought; but if it falleth out otherwiſe, then it is erroneous.

As in the firſt Queſtion of this Chapter, 16 (the third Number) being multiplied by 6, (the fourth *Number*,) the Product is 96, and the Product of 8 (the firſt Number) multiplied by 12 (the ſecond Number) is 96, equal to the firſt Product; which proves the Work to be right.

And note, that if in Diviſion any thing remain, ſuch remainder muſt be added to the Product of the third and fourth Terms, and if the ſumm be equal to the Product of the firſt and ſecond (the homogeneal Terms being of one denomination) the Work is right.

CHAP. XII.

The Double Rule of Three Direct.

WE have already delivered the Rules of Single Proportion, and we come now to lay down the Rules of Plural Proportion.

1. Plural Proportion, is when more Operations in the Rule of Three than one, are required before a Solution can be given to the Queſtion propounded. Therefore in Queſtions that require Plurality in Proportion, there are always given more than three Numbers.

2. When there are given five Numbers, and a ſixth is required in Proportion thereunto; then this ſixth Proportion is ſaid to be found out by the double Rule of Three, as in the Queſtion following, *viz.*

If 100 *l.* in 12 Months gain 6 *l.* Intereſt how much will 75 *l.* gain in 9 Months?

3. Queſtions in the double Rule of Three may be reſolved either by two ſingle Rules of Three, or by one ſingle Rule of Three compounded of the five given Numbers.

4. The

4. The double Rule of Three is either Direct or else Inverse.

5. The double Rule of Three Direct, is when unto five given Numbers, a sixth proportional may be found out by two single Rules of Three Direct.

6. The five given Numbers in the double Rule of Three, consist of two Parts, *viz.* First, a Supposition, and Secondly, of a Demand; the Supposition is contained in the three first of the five given Numbers, and the Demand lies in the two last; as in the Example of the second Rule of this Chapter, *viz.* If 100 *l.* in 12 Months gain 6 *l.* Interest, what will 75 *l.* gain in 9 Months? Here the Supposition is expressed in 100, 12, and 6, for it is said if (or suppose) 100 *l.* in 12 Months gain 6 *l.* Interest; and the Demand lieth in 75 and 9; for it is demanded how much 75 *l.* will gain in 9 Months?

7. When your Question is stated, the next thing will be to dispose of the given Numbers in due order and place, as a preparative for Resolution; which that you may do; First, observe which of the given Numbers in the Supposition is of the same Denomination with the Number required; for that must be the second Number (in the first Operation) of the single Rule of Three, and one of the other Numbers in the Suppo-

ſition(it matters not which) muſt be the firſt Number, and that Number in the Demand which is of the ſame Denomination with the firſt, muſt be third Number, which three Numbers being thus placed, will make one perfect Queſtion in the ſingle Rule of Three, as in the forementioned Example: Firſt, I conſider, that the Number required in the Queſtion is the Intereſt or Gain of 75 *l.* therefore that Number in the Suppoſition which hath the ſame name *viz.* 6 *l.* which is the Intereſt or Gain of 100 *l.*) muſt be the ſecond Number in the firſt Operation, and either 100 or 12 (it matters not which) muſt be the firſt Number; but I will take 100, and then for the third Number, I put that Number in the Demand which hath the ſame Denomination with 100, which is 75, (for they both ſignifie Pounds principal,) and then the Numbers will ſtand as you ſee in the Margent.

106—6—75

But if I had for the firſt Number put the other Number in the Suppoſition, *viz.* 12, which ſignifieth 12 Months; then the third Number muſt have been 9, which is that Number, in the Demand which hath the ſame Denomination with the firſt, *viz.* 9 Months, and then they will ſtand as you ſee in the Margent.

12—6—9

There

There yet remain two Numbers to be diſpoſed of, and thoſe are, one in the Suppoſition, and another in the Demand; that which is of the Suppoſition, I place under the firſt of the three Numbers, and the other which is in the Demand I place under the third Number, and then two of the Terms in the Suppoſition will ſtand (one over the other) in the firſt place, and the two Terms in the Demand will ſtand (one over the other) in the third place, as in the Margent.

100---6---75
12   9

or thus

12---6---9
100   75

8. Having diſpoſed, or ordered the Numbers given according to the laſt Rule, we may proceed to a Reſolution; and firſt, I work with the three uppermoſt Numbers, which according to the firſt diſpoſition are 100, 6, and 75, which is as much as to ſay, if 100 *l.* require 6 *l.* (Intereſt) how much will 75 *l.* require? which by the third Rule of the eleventh Chapter I find to be Direct; and by the ſeventh and eighth Rules of the tenth Chapter, I find the fourth proportional Number, to be 4 *l.* 10 *s.* ſo that by the foregoing ſingle Queſtion, I have diſcovered how much Intereſt 75 *l.* will gain in 12 Months; the Operation whereof followeth

on the left hand under the Letter *A*; and having diſcovered how much 75 *l.* will gain in 12 Months, we may by another Queſtion eaſily diſcover how much it will gain in 9 Months; for this fourth Number (thus found) I put in the middle between the two loweſt Numbers of the five, after they are placed according to the ſeventh Rule of this Chapter; and then it will be a ſecond Number, in another Queſtion in the Rule of Three,

m. l. s. m.

the Numbers being 12——4——10——9 the firſt and third Numbers being of one denomination, *viz.* both Months, and may be thus expreſſed, if 12 Months require 4 *l.* 10 *s.* Intereſt, what will 9 Months require? And by the third Rule of the eleventh Chapter, I find it to be the Direct Rule, and by working according to the Directions laid down in the ſeventh, eighth, and ninth Rules of the tenth Chapter, I find the fourth proportional Number to the laſt ſingle Queſtion to be 3 *l.* 07 *s.* 06 *d.* which is the ſixth proportional Number to the five given Numbers, and is the Anſwer to the general Queſtion. The Work of the laſt ſingle Queſtion is expreſſed on the right ſide of the Page under the Letter *B*, as followeth.

100

100 —— 6 —— 75

A 12 | 9 B

l. *l.* *l.* *If* 100 6 57 75 ——— 30 42 ——— *l.* *s.* 1|00) 4|50 (4—10 4 ——— *Remains* (50) *Multiply* 20 ——— 1|00) 10|00 (10 *s.* *l.* *s.* *Facit* 4—10	then say *m.* *l.* *s.* *m.* *If* 12—4—10—9 20 ——— 90 *Shillings.* 12 ——— 180 90 ——— 1080 *Pence.* 9 ——— 12) 2|0) *l.* *s.* *d.* 12) 9720 (810 6|7 (3—7—6 ——— 99 72 ——— 12 90 12 84 (0) (0) *Pence.* *l.* *s.* *d.* *Facit* 3—7—6

So that by the foregoing Operation I conclude that if 100 *l.* in 12 Months gain 6 *l.* Interest, 75 *l.* will gain 3 *l.* 7 *s.* 6. *d.* in 9 Months, after the same rate.

The

The Anſwer would have been the ſame, if the 5 given Numbers had been ordered according to the ſecond method, *viz.* as you ſee in the Margent.

12—6—
100 75
9

For firſt, I ſay, if 12 Months gain 6 *l.* what will 9 Months gain? this Queſtion I find to be Direct by the 3*d.* Rule of the 11*th.* Chapter, and by the 7 and 8 Rules of the 10*th.* Chapter, I find the fourth Proportional Number to theſe three to be 4 *l.* 10 *s.*

Thus have I found out what is the Intereſt of 100 *l.* for 9 Months, and I am now to find the Intereſt of 57 *l.* for 9 Months; to effect which, I make this 4*th.* Number (found as before) to be my ſecond Number in the next Queſtion, and ſay, If 100 *l.* require 4 *l.* 10 *s.* what will 75 *l.* require? This Queſtion I find (by the ſaid 3*d.* Rule of the 11*th.* Chapter) to be Direct, and by the ſaid 7*th.* 8*th.* and 9*th.* Rules of the 10*th.* Chapter, I find the Anſwer to be as before, *viz.* 3 *l.* 7 *s.* 6 *d.*

This Rule hath been ſufficiently explained by the foregoing Example, ſo that the Learner may be able to reſolve the following (or any other) Queſtions pertinent to the double Rule of 3 Direct, whoſe Anſwers are there given, but the Operation purpoſely omitted

omitted, to try the Learner's Ability in the Knowledge of what hath been before delivered.

Quest. 2. A second Example in this Rule may be as followeth, *viz.* A Carrier receiveth 42 Shillings for the Carriage of 3 *C.* weight 150 Miles, I demand how much he ought to receive for the Carriage of 7 *C.* 3 *qrs.* 14 *l.* 50 Miles at that rate? *Answer,* 36 *s.* 9 *d.*

Quest. 3. A Regiment of 936 Soldiers eat up 351 quarters of Wheat in 168 Days, I demand how many quarters of Wheat 11232 Soldiers will eat in 56 Days at that rate? *Answer,* 1404 *qrs.*

Quest. 4. If 40 Acres of Grass be mowed by 8 Men in 7 Days; how many Acres shall be mowed by 24 Men in 28 Days? *Answer,* 480 Acres.

Quest. 5. If 48 Bushels of Corn (or other Seed) yield 576 Bushels in 1 Year, how much will 240 Bushels yield in 6 Years at that rate? that is to say; if there were sowed 240 Bushel every one of the 6 Years? *Answer,* 17280 Bushels.

Quest. 6, If 40 Shillings is the Wages of 8 Men for 5 Days, what shall be the Wages of 32 Men for 24 Days? *Answer,* 768 Shillings, or 38 *l.* 8 *s.*

Quest. 7. If 14 Horses eat 56 Bushels of Provinder

Provender in 16 Days, how many Bushels will 20 Horses eat in 24 Days? *Answer*, 120 Bushels.

Quest. 8. If 8 Cannons in 1 Day spend 48 Barrels of Powder, I demand how many Barrels 24 Cannons will spend in 22 Days at that rate? *Answer*, 1728 Barrels.

Quest. 9. If in a Family consisting of 7 persons, there are drunk out 2 Kilderkins of Beer in 12 Days, how many Kilderkins will there be drunk out in 8 Days, by another Family consisting of 14 Persons? *Answer*, 48 Gallons, or 2 Kilderkins and 12 Gallons.

Quest. 10. An Ususer put 75 *l.* out to receive Interest for the same, and when it had continued 9 Months, he received for Principal and Interest 78 *l.* 7 *s.* 6 *d.* I demand at what rate *per Cent. per Annum*, he received Interest? *Answer*, at 6 *l. per Cent. per Annum*.

CHAP.

CHAP. XIII.

The Double Rule of Three Inverse.

1. THE Double Rule of Three Inverſe, is, when a Queſtion in the Double Rule of Three is reſolved by two Single Rules of Three, and one of thoſe Single Rules falls out to be Inverſe, or requires a fourth Number in Proportion reciprocal, (for both the Queſtions are never Inverſe.)

2. In all Queſtions of the double Rule of Three (as well Inverſe as Direct) you are (in the diſpoſing of the five given Numbers) to obſerve the ſeventh Rule of the twelfth Chapter, and in reſolving it by two ſingle Rules, obſerve to make choice of your Numbers for the firſt, and ſecond, ſingle Queſtions according to the directions given in the eighth Rule of the ſame Chapter, as in the Example following, *viz.*

Queſt. 1. If 100*l.* Principal in 12 Months gain 6 *l.* Intereſt, what Principal will gain 3 *l.* 7 *s.* 6 *d.* in 9 Months?

This

This Question is an Inversion of the first Question of the twilfth Chapter, and may serve for a proof thereof.

In order to a Resolution, I dispose of the five given Numbers according to the seventh Rule of the last Chapter, and being so disposed, will stand as followeth,

12 ——— 100 ——— 9
6 *l.* *s.* *d.*
3—7—6

Or thus,

l. *s.* *d.*
6 ——— 100 ——— 3—7—6
12 9

Here observe, that according to the eighth Rule of the twelfth Chapter, the first Question, if you take it from the five Numbers, (as they are ordered or placed first) will be, If 12 Months require 100 *l.* Principal, what will 9 Months require to make the same Interest? This, according to the third Rule of the 11*th.* Chapter) is Inverse, and the Answer will be found (by the second Rule of the 11*th.* Chapter, to be 133 *l.* 6*s.* 8*d.* the second Question then will be, If 6 *l.* Interest, require 133 *l.* 6 *s.* 8*d.* Principal, how much Principal will 3 *l.*

7 *s.*

s. 6 d. require? This is a direct Rule, and the Answer in direct proportion is 5 l. See the Work.

First I say

```
    m.     l.     m.
If 12——100——9
           12
       ————————  l.   s.  d.
   9) 1200 (133—6—8
       ...
        9              l.   s.  d.
      ———       Facit 133—6—8
        30
        27
      ————
        30
        27
      ————
        (3)
        20
      —————
   9) 60 (6 s.
       54
      ————
       (6)
        12
      ————
   9) 72 (8 d.
       72
      ————
       (0)
```

then

Then I say,

l.	*l.*	*s.*	*d.*	*l.*	*s.*	*d.*
If 6	133	6	8	3	7	6
240	20			20		
1440 *d.*	2666			67		
	12			12		
	5340			140		
	2666			67		
	32000			810 *d.*		
	810					
	320000					
	256					

144|0) 2592000|0 (18000 *d.* or 75 *l.*
144
1152
1152
(0)

So that by the foregoing Work I find that if 6 *l.* Interest be gained by 190 *l.* in 12 Months, 3 *l.* 7 *s.* 6 *d.* will be gained by 75 *l.* in 9 Months.

But if the resolution had been found out by the Numbers as they are ranked in the second place, then the second Question in the

he single Rule would have been Inverse, and the first Question Direct, and the conclusion the same with the first method, viz. 75 *l*.

Quest. 2. If a Regiment consisting of 936 Soldiers can eat up 351 quarters of Wheat in 168 Days, how many Soldiers will eat up 1404 Quarters in 56 Days at that rate? *Answer*, 11232 Soldiers.

Quest. 3. If 12 Students in 8 Weeks spend 48 *l*. I demand how many Students will spend 288 *l*. in 18 Weeks? *Answer*, 32 Students.

Quest. 4. If 48 *l*. serve 12 Students 8 Weeks, how many Weeks will 288 *l*. serve Students? *Answer*, 144 Weeks.

Quest. 5. If when the Bushel of Wheat cost 3 *s*. 4 *d*. the penny Loaf weigheth 12 Ounces, I demand the weight of the Loaf worth 9 pence, when the Bushel cost 10 *s*? *Answer*, 36 Ounces.

Quest. 6. If 48 Pioneers in 12 Days cast Trench 24 Yards long how many Pioneers will cast a Trench 168 Yards long in 6 Days? *Answer*, 252 Pioneers.

Quest. 7. If 12 *C*. weight being carried 100 Miles cost 5 *l*. 12 *s*. I desire to know how many *C*. weight may be carried 150 Miles for 12 *l*. 12 *s*. that rate? *Answer*, 18 *C*.

Quest. 8.

Queſt. 8. If when Wine is worth 30 *per Tun*, 20 pounds worth is ſufficient f the ordinary of 100 Men, how many M will 4 *l.* worth ſuffice when it is wor 24 *l. per Tun*? *Anſwer*, 25 Men.

Queſt. 9. If 6 Men in 24 Days mow 7 Acres, in how many Days will 8 Men mo 24 Acres? *Anſwer*, in 6 Days.

Queſt. 10. If when the Tun of Wine worth 30 *l.* 100 Men will be ſatisfied wi 20 *l.* worth, I deſire to know what th Tun is worth, when 4 *l.* worth will ſati fie 25 Men at the ſame rate? *Anſwer*, 24 *per Tun.*

CHAP. XIV.

The Rule of Three Compoſe of five Numbers.

1. THE Rule of Three Compoſed, i when Queſtions (wherein the are five Numbers given to find a 6 in pro portio

portion thereunto) are resolved by one single Rule of Three composed of the five given Numbers.

2. When Questions may be performed by the double Rule of Three Direct, and it is required to resolve them by the Rule of Three Composed; (first order or rank your Numbers according to the *7th.* Rule of the *12th.* Chapter, then)

The Rule is,

Multiply the Terms or (Numbers) that stand one over the other, in the first place, the one by the other, and make their Product the first Term in the Rule of Three Direct, then multiply the Terms that stand one over the other in the third place, and place their Product for the third Term in the Rule of Three Direct, and put the middle Term of the three uppermost for a second Term; then having found a fourth Proportional, direct to these three, this fourth Proportional so found, shall be the Answer required.

So the first Question of the 12 Chapter, being proposed, *viz.* If 100*l.* in 12 Months gain 6*l.* Interest, what will 75 *l.* gain in 9 Months? The Numbers being ranked (or placed) as is there directed and done.

Then multiply the two first Terms, 100 and 12, the one by the other, and their Product

duct is 1200 (for the first Term;) then multiply the two last Terms 75 and 9 together, and their Product is 675 for the third Term. Then I say, as 1200 is to 6 so is 675 to the Answer, which by the Rule of Three Direct will be found to be 3 *l.* 7*s.* 6 *d.* as was before found.

3. But if the Question be to be answered by the double Rule of Three Inverse, then (having placed the five given Terms as before) multiply the lowermost Term of the first place, by the uppermost Term of the third place, and put the Product for the first Term; then multiply the uppermost Term of the first place, by the lowermost Term of the third place, and put the Product for the third Term, and put the second Term of the Three highest Numbers for the middle Term to those two, then if the Inverse Proportion is found in the uppermost three Numbers, the fourth Proportional direct to these three shall be the Answer; so the first Question of the 13*th.* Chapter being stated, *viz.* If 100 *l.* Principal in 12 Months gain 6 *l.* Interest, what Principal will gain 3 *l.* 7 *s.* 6 *d.* in 9 Months? State the Number as is there directed in the first order, *viz.*

M.	l.	M.		
12 ——	100 ——	9		
l.		l.	s.	d.
6		3 —	7 —	6

then

then reduce the 6*l.* and 3*l.* 7*s.* 6*d.* into Pence, the 6*l.* is 1440*d.* and 3*l.* 7*s.* 6*d.* is 810*d.* then multiply 1440 by 9, the Product is 12960 for the first Term in the Rule of Three Direct, and multiply 810 by 12, the Product is 9720 for the third Term, then I say, As 12960 is to 130*l.* so is 9720 to the Answer, *viz.* 75*l.* as before. But if the Terms had been placed after the second Order, *viz.*

l.	*l.*	*l.*	*s.*	*d.*
6 ——	100 ——	3 —	7 —	6
M.		*M.*		
12		9		

then the Inverse Proportion is found in the lowest Numbers, and having composed the Numbers for a single Rule of Three as in the second Rule foregoing, then the Answer must be found by a single Rule of Three Inverse, for here it falls out to multiply 810 by 12 for the first Number, and 1440 by 9 for the third Number, and then you must say, as 9720 is to 100*l.* so is 12960 to the Answer, which by Inverse Proportion will be found to be 75*l.* as before.

The Questions in the 12*th.* and 13*th.* Chapters may serve for thy farther experience?

CHAP.

CHAP. XV.

Single Fellowship.

1. FELLOWSHIP is that Rule of Plural Proportion, whereby we balance Accompts depending between divers Persons having put together a general Stock, so that they may every Man have his Proportional part of Gain, or sustain his Proportional part of Loss.

2. The Rule of Fellowship is either single, or it is double.

3. The single Rule is when the Stocks propounded are single Numbers, without any respect or relation to time, each Partner continuing his Money in Stock for the same time.

4. In the single Rule of Fellowship, the Proportion is, as the whole Stock of all the Partners, is in Proportion to the total Gain or Loss, so is each Man's particular Share in the Stock, to his particular Share in the Gain or Loss. Therefore take the Total of all the Stocks for the first Term in the Rule of Three, and the whole Gain or Loss for the second Term, and the particular Stocks of

any

any one of the Partners for the third Term; then multiply and divide according to the 7th. Rule of the 9th. Chapter, and the 4th. Proportional Number is the particular Loss or Gain of him whose Stock you made your second Number; wherefore repeat the Rule of Three as often as there are particular Stocks, or Partners in the Question, and the 4th. Terms produced upon the several operations are the respective Gain or Loss of those particular Stocks given, as in the Examples following.

Quest. 1. Two Persons, *viz*. A and B, bought a Tun of Wine, for 20 *l*. of which A paid 12 *l*. and B paid 8 *l*. and they gained in the Sale thereof 5 *l*. now I demand each Man's Share in the Gains according to his Stock?

First find the summ of their Stocks, by adding them together, *viz*. 12 *l*. and 8 *l*. which are 20 *l*. then according to this Rule I say first, If 20 *l*. (the summ of their Stocks) require 5 *l*. the total Gain, how much will 12 *l*. (the Stock of A) require? Multiply and divide by the 7th. Rule of the 9th. Chapter, and the Answer is 3 *l*. for the

12
8
20 *l*.

Share of A in the gains; then again I say, if 20 *l.* require 5 *l.* what will 8 *l.* require? The Answer is 2 *l.* which is the Gain of B: so I conclude that the Share of A in the Gain is 3 *l.* and the Share of B in the Gain is 2 *l.* which in all is 5 *l.*

$$\begin{array}{l} \quad\ \ l. \quad\ l. \quad\ l. \\ If\ 20 - 5 - 12 \\ \qquad\quad\ \ 12 \\ \hline 20)\ 60\ (3\ l. \\ \qquad 60 \\ \hline \qquad (0) \end{array}$$

$$\begin{array}{l} \quad\ \ l. \quad\ l. \quad\ l. \\ If\ 20 - 5 - 8 \\ \qquad\quad\ \ 8 \\ \hline 20)\ 40\ (2\ l. \end{array}$$

Quest. 2. Three Merchants, *viz.* A, B and C, enter upon a joint Adventure; A put into the common Stock 78 *l.* B put in 117 *l.* and C put in 234 *l.* and they find (when they make up their Accompts) that they have gained in all 264 *l.* now I desire to know each Man's particular Share in the Gains?

First I add their particular Stocks together, and their summ is 429 *l.* then say, If 429 *l.* gain 264 *l.* what will 78 *l.* gain? And what 117 *l.* and what will 234 *l.* (the Stocks of A, B, and C,) gain? work by three several Rules of Three, and you will find that

78
117
234
Summ 429

The

			l.
The Gain of	A	is	48
	B		72
	C		144
		Summ	264

Quest. 3. Four Partners, *viz.* A, B, C, and D, between them built a Ship, which cost 1730 *l.* of which A paid 346 *l.* B 519 *l.* C 692 *l.* and D 173 *l.* and her Freight for a certain Voyage is 370 *l.* which is due to the Owners, or Builders, I demand each Man's Share therein, according to his charge in Building her?

Answer,

	l.
A	74
B	111
C	148
D	37
Summ	370

Quest. 4. A, B, and C, enter Partnership for a certain time, A put into the common Stock 364 *l.* B put in 482 *l.* C put in 500 *l.* and they gained 867 *l.* now I demand

mand each Mans Share in the Gain proportionable to his Stock?

Answer,

	l.
A	234—09—3 $\frac{154}{1346}$
B	310—09—5 $\frac{62}{1346}$
C	322—01—3 $\frac{930}{1346}$
Summ	867—00—0

5. To prove the Rule of Single Fellowship, add each Man's particular Gains or Loss together, and if the total summ is equal to the general Gain or Loss, then is the Work rightly performed, but otherwise it is erroneous. Example, in the first Question of this Chapter, the Answer was, that the Gain of A was 3 *l.* and the Gain of B 2 *l.* which added together makes 5 *l.* equal to the total Gain given.

The proof of the Rule of Single Fellowship.

If in finding out the particular Shares of the several Partners, any thing remain after Division is ended, such Remainders must be added together (they being all Fractions of the same denomination) and their summ divided by the common Divisor in each Question

Question, (*viz.* the total Stock,) and the Quotient add to the particular Gains, and then if the Total Summ is equal to the Total Gain, the Work is right, otherwise not.

As in the fourth Question, the Remainders were 354, 62, and 930, which added together make 1346, which divided by 1346 (the summ of their Stocks,) the Quotient is 1 *d.* which I add to the Pence, *&c.* and the summ of their Shares is 867 *l.* equal to the Tatal Gain; wherefore I conclude the Work is right.

CHAP. XVI.

Double Fellowship.

1. DOUBLE FELLOWSHIP, is when several Persons enter into Partnership for unequal time, that is when every Man's particular Stock hath relation to a particular time.

2. In the Double Rule of Fellowship, multiply each particular Stock by its respective time, and having added the several

Products together, make their summ the first Number (or Term) in the Rule of Three, and the Total Gain or Loss the second Number, and the Product of any one's particular Stock by his time the third Term, and the fourth Number in proportion thereunto is his particular Gain or Loss, whose Product of Stock and Time is your third Number.

Then repeat (as in single Fellowship) the Rule of Three, as often as there are Products (or Partners) and the fourth Terms thereby Invented are the Numbers required. Example.

Quest. 1. A and B enter Partnership; A put in 40 *l.* for three Months, B put in 75 *l.* for four Months, and they gained 70 *l.* now I demand each Man's Share in the Gains, proportionable to his Stock and Time? Answer. A 20 *l.* B 50 *l.*

To resolve this Question, I first multiply the Stock of A (*viz.* 40*l.*) by its time (three Months,) and the Product is 120; then I multiply the Stock of B by its time (*viz.* 75 by 4) and it produceth 300, which I add to the Product of A his Stock and

	l.		*l.*
	40		75
	3		4
A	120	B	300
			120
		Summ	420

Time

Tiem, and the summ is 420 l. Then by the Rule of Three Direct, I say; As 420 (the summ of the Products, is to 70 (the Total Gain,) so is 120 (the Product of A his Stock and time) to 20 l. (the Share of A in the Gains.) Then I say again, as 420 is to 70, so is 300 to 50 l. (the Share of B in the Gains.) And so much ought each to have for his Share.

Quest. 2. A, B, and C, make a Stock for 12 Months, A put in at first 364 l. and 4 Months after that, he put in 40 l. B put in at first 408 l. and at the end of 7 Months he took out 88 l. C put in at first 148 l. and 3 Months after he put in 86 l. more, and 5 Months after that, he put in 100 l. more, and at the end of 12 Months their gain is found to be 1436 l. I desire to know each Man's Share in the Gains according to his Stock and Time?

First, I consider, that the whole time of their Partnership is 12 Months; then I proceed to find out the several Products or Stock and Time as followeth.

A had at first 364 *l.* for 4 Months, wherefore their Product is	1456
Then he put in 40 *l.* which with the first summ makes 404 *l.* which continued the remainder of the Time, *viz.* 8 Months, and their Product is	3232
The summ of the Products of the Stock and Time of A is	4688
B had 408 *l.* in 7 Months, whose Product is	2856
And then took out 86 *l.* therefore he left in Stock 322 *l.* which continued the rest of the Time, *viz.* 5 Months, whose Product is	1610
The summ of the Products of the Stock and Time of B is	4466
C put in 148 *l.* for 3 Months, whose Product being multiplied, is	444
Then he put in 86 *l.* which added to the first, (*viz.* 148) makes 234 *l.* which lay in Stock 5 Months, their Product is	1170

Then

Then he put in 100 *l.* more; so then he had in Stock 334 *l.* which continued the Remainder of the time, (*viz.* 4 Months,) which multiplied together, produce } 1336

The summ of the Product of the Money and Time of C is } A 2950, B 4166, C 4688

The total Summ of all the Product is } 12104

Then I say, as 12104 is to 1436, (the total Gain,) so is 2950, to the Share of A in the Gains, &c. go on as in the foregoing Examples, and you will find their Shares in the Gain to be as followeth, *viz.*

Answer,

		l.	*s.*	*d.*
The Share of	A is	356	03	$6\frac{6192}{12104}$
	B is	529	16	$9\frac{5496}{12104}$
	C is	349	19	$8\frac{416}{12104}$
		1436	00	00

Quest. 3. Three Grasiers, A, B, and C, take a piece of Ground for 46 *l.* 10 *s.* in which A put 12 Oxen for 8 Months, B put in 16 Oxen for 5 Months, and C put

18 Oxen for 4 Months, now the Question is, what shall each Man pay of the 46 *l.* 10 *s.* for his Share in that charge?

Answer,

		l.	*s.*
A	shall pay	18	00
B	shall pay	15	00
C	shall pay	13	10
		46	10

3. The proof of this Rule is the same with that of Single Fellowship, laid down in the 5*th*. Rule of the 15*th*. Chapter; and note that,

If a loss be sustained instead of Gain amongst Partners, every Man's Share to be born in the Loss, is to be found after the same method as their Gain, whether their Stocks be for equal or unequal Time.

C H A P

CHAP. XVII.

Alligation Medial.

1. THE Rule of Alligation is that Rule in plural proportion, by which we resolve Questions, wherein is a Composition or Mixture of divers Simples, as also it is useful in the Composition of Medicines both for Quantity, Quality, and Price. And its Species are two, *viz.* Medial and Alternate.

2. Alligation Medial is when having the several Quantities, and Prices of several Simples propounded we discover the mean Price, or Rate of any quantity of the mixture compounded of those Simples, and the proportion is,

As the summ of the Simples to be mingled is to the total Value of all the Simples, so is any Part or Quantity of the Composition or Mixture, to its mean Rate or Price.

Quest. 1. A Farmer mingled 20 Bushels of Wheat at 5 *s. per* Bushel, and 36 Bushels of Rye at 3 *s. per* Bushel, with 40 Bushels of Barley at 2 *s. per* Bushel; Now I desire to know what one Bushel of that Mixture is worth?

To

To resolve this Question add together the given Quantities, and also their Values, which is 96 Bushels, whose total Value is 14 *l.* 8 *s.* as appeareth by the Work following; for

	bush.	*l.*
	20 *of Wheat at* 5s per *bushel, is*	05-00
	36 *of Rye at* 3 s. per *bushel, is*	05-08
	40 *of Barly at* 2 s. per *bushel, is*	04-00
The summ of the given quantities is	96 *and their Value is*	14-08

Then say by the Rule of Three Direct.

If 96 Bushels cost (or is worth) 14 *l.* 8 *s.* what is 1 Bushel worth?

b. *l.* *s.* *b.*
96——14——8——1
20

96) 288 (3 *s.*
288 *Facit* 3 *s. per bushel.*

(0)

Quest. 2 A Vintner mingleth 15 Gallons of Canary at 8 *s. per* Gallon with 20 Gallons of Malaga at 7 *s.* 4 *d. per* Gallon, with 10 Gallons of Sherry at 6 *s.* 0 *d. per* Gallon, and 24 Gollons of White-Wine at 4 *s. per* Gallon,

Gallon; now I demand what a Gallon of that Mixture is worth? Work as in the last Question, and you will find the Answer to be 6 *s.* 2 *d.* 2 *qrs.* $\frac{46}{69}$.

Quest. 3. A Grocer hath mingled 3 *C.* of Sugar at 56 *s.* *per C.* with 3 *C.* of Sugar at *l.* 14 *s.* 8 *d.* *per C.* and with 6 *C.* at 1 *l.* 7 *s.* 4 *d.* *per C.* I desire to know the Price of a hundred weight of that Mixture? *Answer* 2 *l.* 13 *s.* 1 *d.* $\frac{7}{13}$.

The proof of Allig. medial.

3. The proof of this operation is by the Price of any quantity of the Mixture to find out the total Value of the whole Composition, and if it is equal to the total Value of the several Simples, the Work is right, otherwise it is not. And in the first Example, the Answer to the Question was of that 3 *s*, is the Price of one Bushel; wherefore I say by the Rule of Proportion, If 1 Bushel be 3 Shillings, what is 96 Bushels? *Answer* 14 *l.* 8 *s.* which is the total Value of the several Simples, wherefore the Work is right.

CHAP.

CHAP. XVIII.

Alligation Alternate.

1. ALligation Alternate is when there are given the particular Prices of several Simples, and thereby we discover such quantities of those Simples, as being mingled together shall bear a certain rate propounded.

2. When such a Question is stated, place the given Prices of the Simples one over the other, and the propounded Price of the Composition against them in such sort that it may represent a Root, and they so many Branches springing from it, as in the following Example.

Quest. 1. A certain Farmer is desirous to mix 20 Bushels of Wheat at 5 *s.* or 60 *d. per* Bushel with Rye at 3 *s.* or at 36 *d. per* Bushel, and with Barly at 2 *s.* or 24 *d. per* Bushel, and Oates at 1 *s.* 6 *d. per* Bushel, and desireth to mix such a quantity of Rye, Barly, and Oates with the 20 Bushels of Wheat, as that the whole Composition may be worth 2 *s.* 8 *d.* or 32 *d. per* Bushel.

The

The prices of the Simples being placed according to the laſt Rule, with the price of the Compoſition propounded as a Root to them, will ſtand as followeth,

$$32\left\{\begin{array}{l}60 \text{ *Pence.*}\\36\\24\\18\end{array}\right.$$

3. Having thus placed the given Numbers you are to link or combine the ſeveral rates of the Simples the one to the other, by certain Arches, in ſuch ſort that one that is leſſer than the root (or mean rate) may be linked or coupled to another that is greater than the mean rate, ſo the Queſtion laſt propounded will ſtand,

1 *thus,*

$$32\left\{\begin{array}{l}60\\36\\24\\18\end{array}\right.$$

2 *or thus,*

$$32\left\{\begin{array}{l}60\\36\\24\\18\end{array}\right.$$

3 *or thus,*

$$32\left\{\begin{array}{l}60\\36\\24\\18\end{array}\right.$$

4. Then

4. Then take the difference between the Root and the ſeveral Branches, and place the difference of each againſt the Number or Branch with which it is coupled, or linked; and having taken all the differences, and placed them as aforeſaid, then thoſe differences ſo placed, will ſhew you the Number of each Simple to be taken, to make a Compoſition to bear the mean rate propounded.

So the Branches of the laſt Queſtion being linked together, as in the firſt manner, I ſay the difference between 32 and 60, is 28, which I put againſt 18, becauſe 60 is linked with 18; then the difference between 32 and 36 is 4, which I put againſt 24, becauſe 36 is linked or coupled with 24; then I ſay the difference between 32 and 24 is 8, which I place againſt 36, (for the reaſon aforeſaid;) then I ſay the difference between 32 and 18 is 14, which I place againſt 60; and then the Work will ſtand as you ſee in the Margent.

32	60	14
	36	8
	24	4
	18	28

So I conclude that a Compoſition made of 14 Buſhels of Wheat at 60 *d. per* Buſhel, and

and 8 Bushels of Rye at 36 *d. per* Bushel, and 4 Bushels of Barly at 24 *d. per* Bushel, and 18 Bushels of Oats at 18 *d. per* Bushel, will bear the mean price of 32 *d.* or 2 *s.* 8 *d. per* Bushel. And here observe that in this Composition there is but 14 Bushels of Wheat; but I would mingle 20 Bushels, and this kind (or rather case) of Alligation Alternate, (*viz.* when there is given a certain quantity of one of the Simples, and the quantities of the rest sought to mingle with this given quantity, that the whole may bear a price propounded,) is called Alternation partial.

And the proportion to find out the several quantities to be mingled with the given quantity is as followeth, *viz.*

As the difference annexed to the branch that is the Value of an Integer of the given quantity, is to the other particular differences; so is the quantity given, to the several quantities required.

So here, to find out how much Rye, Barly, and Oats, must be mingled with the 20 Bushels of Wheat, I say by the single Rule of three Direct, if 14 Bushels of wheat require 8 Bushels of Rye, what will 20 Bushels of Wheat require? Answer $11\frac{6}{14}$ Bushels of Rye.

Again if 14 Bushels of Wheat require 4 Bushels of Barly, what will 20 Bushel of Wheat

Wheat require? Anſwer $5\frac{20}{14}$ Buſhels of Barly. Again, I ſay, if 14 Buſhels of Wheat require 28 Buſhels of Oats, what will 20 Buſhels of Wheat require? Anſwer 40 Buſhels of Oats.

And now I ſay that 20 Buſhels of Wheat mingled with $11\frac{6}{14}$ Buſhels of Rye, and $5\frac{20}{14}$ Buſhels of Barly, and 40 Buſhels of Oats, each bearing the rates as aforeſaid, will make a compoſition or heap of Corn that may yield 32 *d. per* Buſhel.

But if the Branches had been coupled according to the ſecond order, or manner, the differences would have been thus placed, *viz.* the differences between 32 and 60 is 28, which I ſet againſt 24, becauſe 60 is linked thereto; and the difference between 32 and 36 is 4, which I ſet againſt 18, and the difference between 32 and 24 is 8, which I ſet againſt 60; then the difference between 32 and 18 is 14, which I ſet againſt his yoke-fellow 36; and then I conclude that if you mix 8 Buſhels of Wheat with 14 Buſhels of Rye, 28 Buſhels of Barly, and 4 Buſhels of Oats, each bearing the foreſaid prices, the whole mixture

may

may be sold for 32 *d. per* Bushel, as by the Work in the Margent.

You see by this Work we have found how many Bushels of Rye, Barly, and Oats, ought to be mixed with 8 Bushels of Wheat, and to find out how many of each ought to be mixt with 20 Bushels of Wheat, I say, As 8 is to 14, so is 20 to 35 Bushels of Rye. As 8 is to 28, so is 20 to 70 Buthels of Barly. As 8 is to 4, so is 20 to 10 Bushels of Oats; whereby I conclude, that if to 20 Bushels of Wheat, I put 35 Bushels of Rye, 70 Bushels of Barly, and 10 Bushels of Oats, bearing each the foresaid prices *per* Bush. that then a Bushel of this mixture will be worth 32 *d.* or 2 *s.* 8 *d.*

And if the Branches had been linked as you see in the third place, where each branch bigger than the root, is linked to two that are lesser than the root, then in this case you must have placed the several differences between the root and branches, against those two with which each is coupled: as first the difference between 32 and 60 is 28, which I put against 24 and 18, because it is coupled

32	60	8, 14	22
	36	8, 14	22
	24	28, 4	32
	17	28, 4	32

wiht

with them both; then the difference betwe
32 and 36 is 4, which I set likewise again
24 and 18, because 36 is linked to them bot
then the difference between 32 and 24 is
which I put against 60 and 36, because 2
is linked to them both; then the differen
between 32 and 18 is 14, which I put again
60 and 36, the yoke-fellows of 18.

Lastly, I draw a line behind the differen
ces, and add the difference which stand a
gainst each branch, and put the summ be
hind the said Line against its proper branch
as you see in the Margent.

And now by this Work I find that 2
Bushels of Wheat mingled with 22 Bushels
of Rye and 32 Bushels of Barly, and 3
Bushels of Oats, each bearing the said pric
will make a mixture, bearing the mean rat
of 32 *d. per* Bushel.

And to find how much of each of the re
must be mingled with 20 Bushels of Wheat
I say,

As 22 is to 22, so is 20 to 20 Bushels o
Rye. As 22 is to 32, so is 20 to 29$\frac{2}{22}$ Bu
shels of Barly. As 22 is to 23, so is 20 t
29$\frac{2}{22}$ Bushels of Oats.

Whereby you see the Questions of Alli
gation Alternate will admit of more tru
Answers than one; for we have found thre
several Answers to this first Question.

Question

Questions of Alternation partial are proved the same way with Questions in Alligation medial, which you may see in the 3 *d.* Rule of the 17*th.* Chapter.

The proof of Alternation partial.

Quest. 2. A Grocer hath 4 sorts of Sugar, *viz.* of 12 *d. per l.* of 10 *d. per l.* of 6 *d. per l.* and of 4 *d. per l.* and he would have a Composition worth 8 *d. per l.* the whole quantity whereof should contain 144 *l.* made of these 4 sorts; I demand how much of each he must take?

Questions of this Nature are resolved by that part of Alligation Alternate called by Arithmeticians Alternation total, *viz.* where there is given the summ, and prices of several Simples to find out how much of each Simple ought to be taken to make the said summ, or quantity, so that it may bear a certain rate propounded.

To resolve this Question I place the several prices of the Simples and mean rate propounded, and link them together, as is directed in the second and third Rules of this Chapter, and place the differences between the root and branches, according to the 4*th.* Rule of this Chapter, which will then stand one of these three ways, *viz.*

First,

First.

8	12	4
	10	2
	6	2
	4	4
		12

Second.

8	12	2
	10	4
	6	4
	4	2
		12

Third.

8	12	2,4	6
	10	2,4	6
	6	4,2	6
	4	4,2	6
			24

5. Then add the ſeveral differences together, which I have done, and the ſumms of the firſt and ſecond order are 12 *l.* and of the third 24 *l.* as you may ſee above; but it is required that there ſhould be 144 *l.* of the Compoſition, therefore to find the quantity of each Simple, to make the whole Compoſition 144 *l.* obſerve this general Rule, *viz.*

As the ſumm of the differences is to the ſeveral differences, ſo is the total quantity of the Compoſition to the quantity of each Simple.

So

So to find how much of each sort of Sugar ought to take to make 144 *l.* at 8 *d. per l.* say,

l.

As 12 is to 4, so is 144 to 48 *l.* at 12 *d. per l.*
As 12 is to 2, so is 144 to 24 *l.* at 10 *d. per l.*
As 12 is to 2, so is 144 to 24 *l.* at 6 *d. per l.*
As 12 is to 4, so is 144 to 48 *l.* at 4 *d. per l.*

Whereby I find that 48 *l.* at 12 *d. per l.* and 24 *l.* at 10 *d. per l.* and 24 *l.* at 6 *d. per l.* and 48 *l.* at 4 *d. per l.* will make a Composition of Sugar containing 144 *l.* worth 8 *d. per l.*

But as the branches are linked in the second order, the Answer will be 24 *l.* at 12 *d. per l.* and 48 *l.* at 10 *d. per l.* and 48 *l.* at 6 *d. per l.* and 24 *l.* at 4 *d. per l.* to make the said quantity, and to bear the said price.

And if you had worked as the branches are linked after the third order, then you would have found the quantity of 36 *l.* of each.

Quest. 3. A Vintner hath four sorts of Wine, *viz.*, Canary at 10 *s. per* Gallon, Malaga at 8 *s. per* Gallon, Rhenish Wine at 6 *s. per* Gallon, and White Wine at 4 *s. per* Gallon, and he is minded to make a Composition of them all of 60 Gallons that may be worth 5 *s. per* Gallon, I desire to know how much of each he must have?

The

The Numbers or Terms being ranked ac-cording to the ſecond Rule of this Chapter, the branches will be linked as followeth, and will admit of no other manner of coupling, becauſe there is but one branch that is leſſer than the root, therefore all the reſt muſt be linked unto it; and the differences between the root and the three firſt branches, *viz.* 10, 8, and 6, which are 5, 3, and 1, muſt be ſet againſt 4, because they are all coupled with it; and the difference between the Root (*viz.* 5) and 4, which is 1, muſt be ſet againſt the 3 other, becauſe it is linked to them all; ſo I find 1 gallon of Canary, 1 gallon of Malaga, 1 gallon of Reniſh wine, and 9 gallons of White-wine, prized as above, being mingled together, will be worth 5*s.per* gallon, the ſumm being 12 gallons; but there muſt be 60 gallons; wherefore I ſay,

5	10	1	1
	8	1	1
	6	1	1
	4	5, 3, 1	9
			12

As 12 is to 1, ſo is 60 to 5 gallons of Can.
As 12 is to 1, ſo is 60 to 5 gallons of Mal.
As 12 is to 1, ſo is 60 to 5 gallons of Rhen.
As 12 is to 9, ſo is 60 to 45 gallons of White (wine.

So that 5 gallons of Canary, 5 gallons of Malaga, 5 gallons of Rheniſh, and 45 gallons

lons of White-wine mingled together, will be in all *60* gallons, worth 5 *s.* *per* gallon, which was required.

Quest. 4. A Goldsmith hath Gold of 4 several sorts of fineness, *viz.* of 24 Carects fine, and of 22 Carects fine, of 20 Carects fine, and of 15 Carects fine. And he would mingle so much of each with Alloy, that the whole Mass of 28 Ounces of Gold so mingled may bear 17 Carects fine. I demand how much of each he must take? The second and third Rules of this Chapter being observed, (for instead of the alloy I put 0, because it bears no fineness, but it makes a branch in the Operation) and the Terms may be alligated, and the differences added, any of these four ways following, *viz.*

Read Chap. 2. diff. 2. of this Book.

First thus,

17	24	17	17
	22	2	2
	20	1, 17	19
	15	5, 3	8
	0	7, 3	10
		Summ	56

M *Secondly,*

Secondly thus,

	24	2	2
	22	17	17
17	20	2,17	19
	15	7, 3,	10
	0	5, 3,	8
		Summ	56

Secondly thus,

	24	2,	2
	22	2,	2
17	20	2,17	19
	15	7,5,3,	15
	0	3,	3
		Summ	41

Fourthly thus,

	24	2, 17	19
	22	2, 17,	19
17	20	2, 17,	19
	15	7,5, 3	15
	0	7,5, 3	15
		Summ	87

More ways may be given for the Alligating, or linking of the Terms in this Question, but these are sufficient for the industrious, and it shall also suffice to give an Answer to the Question as the Terms are link'd the first way, not doubting but the ingenious Practicioner will be able at his leisure, to find Answers to the other three ways, *viz.*

	oz.	*p.w.*	*Car.*
As 56 is to 17, so is 28 to	8 ——	10	of 24
As 56 is to 2, so is 28 to	10 ——	00	of 22
As 56 is to 19, so is 28 to	9 ——	10	of 20
As 56 is to 18, so is 28 to	4 ——	00	of 15
As 56 is to 10, so is 28 to	5 ——	00	of Alloy.

Thus mnch well practised and understood is sufficient for the understanding of Alligation.

The P. oof of Alternation total.

In Questions of Alternation total, the Answer is given true, when the summ of of each of the quantity of Simples found, agrees with the summ or quantity propounded; as in the last question, the Answer was 8 *oz.* 10 *p.w.* of 24 Carects fine, 10 *oz.* of 22 Carects fine, 9 *oz.* 10 *p.w.* of 20 Carects fine, 4 *oz.* of 15 Carects fine, and 5 *oz.* of Alloy, which added together make 28 *oz.* the quantity propounded.

CHAP. XIX.

Reduction of Vulgar Fractions.

1. WHat a Vulgar Fraction is, and its parts and ſeveral kinds, hath been already ſhewed in the 19, 20, 21, 22, 23, 24, and 31 Definitions of the firſt Chapter of this Book, which the Learner is deſired diligently to obſerve before he proceeds.

2. To reduce a Vulgar Fraction (which diſcovereth the Principal knowledge of Fractions, and therefore ought greatly to be regarded) we ſhall diſcover plainly under theſe eight ſeveral Heads (or Rules) following, *viz.*

1. To reduce a mixt Number into an improper Fraction.

2. To reduce a whole Number into an improper Fraction.

3. To reduce an improper Fraction into its equivalent whole (or mixt) Number.

4. To

4. To reduce a Fraction into its loweſt Terms equivalant to the Fraction given.

5. To find the value of a Fraction in the known parts of Coyn, Weight, Meaſure, *&c.*

6. To reduce a compound Fraction to a ſimple one of the ſame value.

7. To reduce divers Fractions having unequal Denominators, to Fractions of the ſame value, having an equal Denominator.

8. To reduce a Fraction of one denomination to another of the ſame value.

---

1. To reduce a mixt Number to an improper Fraction.

The Rule is, *Vide Chap.* 1. *defin.* 31.

Multiply the Integral part (or whole Number) by the Denominator of the Fraction, and to the Product add the Numerator, and that ſumm place over the Denominator for a new Numerator; ſo this new Fraction ſhall be equal to the mixt Number given. As for Example,

1. Reduce $18\frac{3}{7}$ into an improper Fraction, multiply the whole Number 18 by 7 the Denominator, and to the Product add the Numerator 3, the summ is 129 which put over the Denominator 7, and it makes $\frac{129}{7}$ for the Answer, as *per* Margent.

$$\begin{array}{r} 18\frac{3}{7} \\ 7 \\ \hline 129 \end{array}$$

Facit $\frac{129}{7}$

2. Reduce $183\frac{5}{12}$ to an improper Fraction, *Facit* $\frac{2201}{12}$.

3. Reduce $56\frac{13}{21}$ to an improper Fraction, *Facit* $\frac{1189}{21}$.

I. *To reduce a whole Number into an improper Fraction.*

The Rule is,

Vide Ch. 1. *defin.* 23.

Multiply the given Number, by the intended Denominator, and place the Product for a Numerator over it. As for Example:

1. Let it be required to reduce 15 into a Fraction whose Denominator shall be 12. To

To effect which, I multiply 15 by the intended Denominator (12) the Product is 180, which I place over 12 as a Numerator, and it makes $\frac{180}{12}$, which is equal to 15, as was required; as *per* Margent.

	15
	12
	30
Facit $\frac{180}{12}$	15
	180

2. Reduce 36 into an improper Fraction whose Denominator shall be 26, *Facit* $\frac{936}{26}$.

3. Reduce 135 into an improper Fraction, whose Denominator shall be 16, *Facit* $\frac{2160}{16}$.

III. *To reduce an improper Fraction into its equivalent, whole or mixt Number.*

The Rule is,

Divide the Numerator by the Denominator, and the Quotient is the whole Number equal to the Fraction, and if any thing remain, put it for a Numerator over the Divisor. Example,

1. Reduce $\frac{436}{8}$ into its equivalent mixt Number, divide the Numeratator 436 by the Denominator 8, and the Quotient is 54 and 4 remains, which put for a Numerator over the Divisor 8, the Answer is $54\frac{4}{8}$, as per Mergent.

8) 436 (54
40
Facit $54\frac{4}{8}$
36
32
4

2. Reduce $\frac{3476}{15}$ to a mixt Number, *Facit* $231\frac{11}{15}$.

3. Reduce $\frac{15576}{136}$ to a mixt Number, *Facit* $114\frac{72}{136}$.

IV. *To reduce a Fraction into its lowest Terms equivalent to the Fraction given.*

The Rule is,

1. If the Numerator and Denominator are even Numbers, take half of the one and half of the other as often as may be, and when either of them falls out to be an odd Number, then divide them by any Number that you can discover will divide both Numerator and Denominator without any Remainder; and when you have thus proceeded as low as you can reduce them, then this new Fraction so found out shall be the Fraction you desire, and will be

in

in Value equal to the given Fraction. Example.

1. Let it be required to reduce $\frac{192}{336}$ into its lowest Terms. First I take the

192	96	48	24	12	4
336	168	84	42	21	7

half of the Numerator 192 and it is 96, then half of the Denominator and it is 168, so that now it is brought to $\frac{96}{168}$, and next to $\frac{48}{84}$, and by halfing still to $\frac{24}{42}$ and their half is $\frac{12}{21}$ and now I can no longer half it, because 21 is an odd Number, wherefore I try to divide them by 3, 4, 5, 6, *&c.* and I find 3 divides them both without any Remainder, and brings them to $\frac{4}{7}$ as *per* Margent.

So I conclude $\frac{4}{7}$ thus found to be equal in value to the given Fractions $\frac{192}{335}$.

2. What is $\frac{1036}{1184}$ in its lowest Terms? Answer $\frac{7}{8}$

3. What is $\frac{1342}{1585}$ in its lowest Terms? Answer $\frac{11}{13}$.

There is yet another way more excellent than the former to reduce a Fraction into its lowest Terms, and that is by finding a common measurer, *viz.* the greatest Number that will divide the Numerator and Denominator without any remainder, and by that means reduce a Fraction to its lowest Terms at the

Vide Ought. Clav. Math. Cap. 7.

the first Work; and to find out this common Measure, divide the Denominator by the Numerator, and if any thing remain divide your divisor thereby; and if any thing yet remains, then divide your last divisor by it; do so untill you find nothing remains; then this last divisor shall be the greatest common Measurer, which will divide both Numerator, and Denominator, and reduce them into their lowest Terms at one Work. Example,

4. Reduce $\frac{228}{304}$ into its lowest Terms by a common Measurer. To effect which, I divide the Denominator, 304 by the Numerator 228 and there remains 76, then I divide 228, (the first divisor) by 76 (the remainder) and it quotes 3, and nothing remains; wherefore the last divisor 76 is the common Measurer, by which I divide the Numerator of the given Fraction, *viz.* 228, it quotes 3 for a new Numerator, then I divide the Denominator 304 by 76 and it quotes 4 for a new Denominator, so that now I have found $\frac{3}{4}$ equal to $\frac{228}{304}$.

5. Reduce $\frac{6048}{7392}$ into its lowest Terms by a common Measurer, *Facit* $\frac{9}{11}$.

6. Reduce $\frac{3081}{20381}$ into its lowest Terms by a common Measurer, *Facit* $\frac{13}{85}$.

A Compendium.

Note, that if the Numerator and Denominator

minator of a Fraction, and each with a Cypher or Cyphers, then cut off as many Cyphers from the one as from the other, and the remaining Figures will be a Fraction of the same value, *viz.* $\frac{3400}{7100}$ will be found to be reduced to $\frac{34}{71}$ by cutting off the 2 Cyphers from the Numerator and Denominator, with the dash of the Pen, thus, $\frac{34|00}{71|00}$, and $\frac{460}{7000}$, will be $\frac{46}{70}$ thus $\frac{46|0}{70|00}$, *&c.*

V. *To find the Value of a Fraction in the known Parts of Coyn, Weight,* &c.

The Rule is

Multiply the Numerator by the parts of the next inferiour Denomination that are equal to an Unit of the same denomination with the Fraction, then divide that Product by the Denominator, and the quote gives you its value, in the same parts you multiplied by, and if any thing remain multiply it by the parts of the next inferiour denomination, and divide as before; do so till you can bring it no lower, and the several Quotients will give you the value of the Fraction, as was required, and if any thing at last remain, place it for a Numerator over the former Denominator, some few Examples will make the Rule plain.

1. What

1. What is the value of $\frac{27}{29}$ *l. Sterling*? To Anſwer this Queſtion I multiply the Numerator 27 by 20 (the Shillings in a Pound) the Product is 540, which I divide by 29 (the Denominator) and the Quotient is 18 *s.* and there remains 18, which I multiply by 12 Pence, and the Product (216) I divide by the Nominator 29, the Quotient is 7 Pence and 13 remains, which I multiply by 4 Farthings, the Product is 52, which I ſtill divide by 29, the Quotient is 1 Farthing, and there remaineth 23, which I put for a Numerator over the Denominator 29; ſo I find the value of $\frac{27}{29}$ *l.* to be 18 *s.* 7 *d.* 1 *qrs.* $\frac{23}{29}$, as by the following Operation; and after the ſame manner are the values of the Fractions in the ſeveral Examples following found out.

$\frac{27}{29}$ *l.*

$\frac{27}{29}$ *l.*

27

Multiply 20

29) 540 (18 *s.*

29

250

232

Remains (18)

Multiply 12

36

18

29) 216 (7 *d.*

203

Remains (13)

Multiply 4

qrs.

29) 52 (1 $\frac{23}{29}$

29

Remains (23)

s. d. qrs.

Facit 18—7—1 $\frac{23}{29}$

2. What is the value of $\frac{11}{15}$ *l. Sterling* ? *Facit* 14 *s.* 8 *d.*

3. What

3. What is $\frac{28}{137}$ *l. Sterling*? *Facit* 4 *s.* 1 *d.* $\frac{7}{137}$.

4. What is $\frac{16}{21}$ *C.* Weight? *Facit* 3 *qrs.* 1 *l.* 5 *oz.* $\frac{7}{21}$.

5. What is $\frac{136}{371}$ *l. Troy* Weight? *Facit* 4 *oz.* 7 *p.w.* 23 *gr.* $\frac{179}{371}$

6. What is $\frac{41}{50}$ of a Year? Anſwer, 299 Days, 7 Hours, and 12 Minutes.

VI. *To reduce a compound Fraction to a Simple one of the ſame value.*

What a compound Fraction is, hath been ſhewed in *Chap.* 1. Definition 24, and to reduce it to a ſimple Fraction of the ſame value.

The Rule is,

Multiply the Numerators continually and place the laſt Product for a new Numerator, then multiply the Denominators continually, and place the laſt Product for a new Denominator. So this ſingle Fraction ſhall be equal to the compound Fraction given.

Example,

1. Reduce $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{5}{8}$ to a ſimple Fraction.

Multiply

Multiply the Numerators 2, 3, and 5, together, they make 30 for a new Nemerator; then I multiply the Denominators 3, 5, and 8 together, and their Product is 120 for a Denominator; so the simple Fraction is $\frac{30}{120}$, and cutting off the Cyphers, it is $\frac{3}{12}$ equal to $\frac{1}{4}$ by the fourth Rule foregoing.

$$\begin{array}{r} 5 \\ 3 \\ \hline 15 \\ 8 \\ \hline 120 \end{array} \qquad \begin{array}{r} 3 \\ 2 \\ \hline 6 \\ 5 \\ \hline 30 \end{array}$$

Facit $\frac{30}{120}$ or $\frac{3}{12}$ or $\frac{1}{8}$.

2. What is $\frac{7}{10}$ of $\frac{5}{9}$ of $\frac{4}{7}$ of $\frac{11}{12}$? Answer, $\frac{1540}{7560}$ or $\frac{154}{756}$ or $\frac{77}{378}$ in its least Terms.

3. What is $\frac{11}{12}$ of $\frac{13}{14}$ of $\frac{21}{29}$? Answer, $\frac{3003}{4872}$.

By this you may know how to find the value of a compound Fraction, *viz.* first reduce it to a simple one, and then find out his value by the 5*th.* Rule foregoing.

Example,

4. What is the value of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{9}{12}$ of a Pound? Answer, 11 *s.* 3 *d.*

VII. *To*

VII. *To reduce Fractions of unequal Denominators to Fractions of the same Value, having equal Denominators.*

The Rule is,

Multiply all the Denominators together, and the Product shall be the common Denominator. Then multiply each Numerator into all the Denominators except its own, and the last Product put for a Numerator over the Denominator found out as before: So this new Fraction is equal to that Fraction, whose Numerator you multiplied into the said Denominators. Do so by all the Numerators given, and you have your desire.

Example,

1. Reduce $\frac{3}{4}$ $\frac{4}{5}$, $\frac{5}{6}$, and $\frac{7}{8}$ to a common Denominator.

Multiply the Denominators 4, 5, 6, and 8, together continually, and the Product is 960 for the common Denominator; then multiply the Numerator 3 into the Denominators, 5, 6, and 8, and the Product is 720, which is a Numerator to 960, (found as before;) so $\frac{720}{760}$ is equal to the first Fraction $\frac{3}{4}$: then I proceed to find a new Numerator

tor

tor the ſecond Fraction *viz.* $\frac{4}{5}$, and I multiply 4 (into all the Denominators except its own; *viz.*) into 4, 6, and 8, which produceth $\frac{768}{960}$ equal to $\frac{4}{5}$, then multiply the Numerator 5, into the Denominator 4, 5, and 8, the Product is $\frac{800}{960}$ equal to $\frac{5}{6}$. Then multiply the Numerator 7 into the Denominators 4. 5, and 6, the Product is $\frac{840}{960}$ equal to $\frac{7}{8}$ and the Work is done; ſo that for $\frac{3}{4}\frac{4}{5}\frac{5}{6}$ and $\frac{7}{8}$ I have $\frac{720}{960}$, $\frac{768}{960}$, $\frac{800}{960}$, and $\frac{840}{960}$.

2. Reduce $\frac{11}{12}$, $\frac{14}{23}$, and $\frac{18}{21}$, into a common Denominator, *faciunt* $\frac{5313}{5796}$, $\frac{3528}{5796}$, and $\frac{5244}{5796}$.

VIII. *To reduce a Fraction of one Denomination to another.*

1. This is either Aſcending, or Deſcending. Aſcending when a Fraction of a ſmaller is brought to a greater Denomination, and Deſcending when a Fraction of a greater Denomination is brought lower.

2. When a Fraction is to be brought from a leſſer to a greater Denomination, then make of it a compound Fraction by comparing it with the intermediate Denominations between it, and that you would have it reduced to, then (by the *6th.* Rule foregoing) reduce your compound to a ſimple Fraction, and the Work is done. Example,

Queſt. 1

Quest. 1. It is required to know wha[t] part of a Pound *Starling* $\frac{5}{7}$ of a Penny is?

To resolve this, I consider that 1 *d.* is [$\frac{1}{12}$] of a Shilling, and a Shilling, is $\frac{1}{20}$ of a Pound wherefore $\frac{5}{7}$ *d.* is $\frac{5}{7}$ of $\frac{1}{12}$ of $\frac{1}{20}$ of a Pound which by the said *6th.* Rule I find to be $\frac{5}{1680}$ of a pound *Sterling* of *English* Money.

Quest. 2. What part of a Pound *Troy* Weight is $\frac{4}{5}$ of a Penny Weight? Answer, [$\frac{4}{5}$] of $\frac{1}{20}$ of $\frac{1}{12}$ *l.* equal to $\frac{4}{1200}$ *l. Troy*.

3. When a Fraction is to be brought from a greater to a lesser denomination then multiply the Numerator by the parts contained in the several denominations betwixt it and that you would reduce it to; then place the last Product over the Denominator of the given Fraction, Example,

Quest. 3. I would reduce $\frac{3}{5}$ *l.* to the Fraction of a Penny? To do which I multiply the Numerator 3 by 20 and 12, the Product is 720, which I put over the Denominator 5, it makes $\frac{720}{5}$ of a Penny, equal to $\frac{3}{5}$ *l.*

Quest. 4. What parts of an Ounce *Troy* is $\frac{5}{16}$ *l.* Answer, $\frac{60}{16}$ *oz.*

CHAP.

CHAP. XX.

Addition of Vulgar Fractions.

1. IF your Fractions to be added have a common Denominator, then add all the Numerators together, and place their summ for a Numerator to the common Denominator, which new Fraction is the summ of all the given Fractions; and if it be improper, reduce it to a whole, or mixt Number, by the 3*d*. Rule of the 19*th*. Chapter.

Quest. 1. What is the summ of $\frac{7}{24}$, $\frac{9}{24}$, $\frac{16}{24}$, and $\frac{14}{24}$?

The Denominators are equal, *viz*. every one is 24, wherefore add the Numerators together, *viz*. 7, 9, 16, and 14, their summ is 46, which put over the Denominator 24, it makes $\frac{46}{24}$ the summ of the given Fractions, which will be reduced to the mixt Number $1\frac{22}{24}$ or $1\frac{11}{12}$,

2. But

2. But if the Fractions to be added hav unequal Denominators, then reduce the to a common Denominator, by the 7t Rule of the 19*th.* Chap. and then add t Numerators together, and put the sum over the common Denominator, &c. as be fore, in the last Example.

Quest. 2. What is the summ of $\frac{3}{5}$, $\frac{7}{8}$, and $\frac{11}{12}$.

The Fractions reduced to a common De nominator are $\frac{2880}{4800}$, $\frac{4200}{4800}$, $\frac{4320}{4800}$, and $\frac{4400}{4800}$, the summ of their Numerators is 15800, which pu over the common Denominator, makes $\frac{158}{48}$ or $\frac{158}{48}$ equal to the mixt Number $3\frac{14}{48}$ or 3 for the summ required.

Quest. 3. What is the summ of $\frac{15}{173}$, $\frac{21}{49}$, an $\frac{36}{47}$? Answer, $1\frac{37555}{39151}$.

3. If you are to add mixt Numbers toge ther, then add the fractional parts as before, and if their summ be an improper Fractio reduce it to a mixt Number, and add its In tegral part to the Integral parts of the gi ven mixt Numbers, and the Work is done.

Quest. 4. What is the summ of $1\frac{3}{4}$ and $2\frac{5}{8}$?

First

First add the Fractions $\frac{3}{4}$ and $\frac{5}{8}$ the summ is $1\frac{12}{32}$, then add this Integer 1, to 13 and 24, their summ is 38, and put after it the Fraction $\frac{12}{32}$ it is $38\frac{12}{32}$ for the Answer, or it is $38\frac{3}{8}$.

Quest. 5. What is the summ of $48\frac{3}{7}$ $64\frac{5}{8}$ and $130\frac{3}{4}$? *Facit* $243\frac{180}{224}$, or $243\frac{45}{56}$.

4. If any of the Fractions to be added is a compound Fraction it must first be reduced to a simple Fraction by the 6*th.* Rule of Chapter 19, and then add it to the rest according to the 2*d.* Rule of this Chapter. Example:

Quest. 6. What is the summ of $\frac{3}{4}$, $\frac{5}{6}$, and $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$.

Reduce $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$ into a simple Fraction, and it is $\frac{105}{192}$ which reduced with the other two, and added, are $1\frac{4686}{5760}$.

Quest. 7. What is the summ of $\frac{11}{12}$ and $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$? Answer, $1\frac{5}{12}$.

5. If the Fractions to be added are not of one denomination, they must be so reduced, and then proceed as before.

Quest. 8. What is the summ of $\frac{3}{4}$ *l.* and $\frac{5}{6}$ *s.*?

Of

Of the given Fractions here one is of a Pound, and the other the Fraction of a Shilling; and before you can add them together, you must reduce $\frac{5}{8}$ *s.* to the Fraction of a Pound as the other is (by the 8*th.* Rule of Chapter 19) and it makes $\frac{5}{160}$ *l.* then $\frac{3}{4}$ *l.* and $\frac{5}{160}$ *l.* will be found to be $\frac{380}{480}$ l. or $\frac{38}{48}$ *l.* by the 7*th.* Rule of Chapter 19, and in its lowest Terms $\frac{19}{24}$ *l.* by the 4*th.* Rule of Chapter 19.

It would have been the same, if (by the latter part of the 8*th.* Rule of Chapter 19) you had reduced $\frac{3}{4}$ *l.* to the Fraction of a shilling which you would have found to have been $\frac{60}{4}$ *s.* which added to $\frac{5}{8}$ *s.* by the said 17*th.* Rule of the last Chapter, the summ is 15 *s.* $\frac{20}{24}$, which is equal to the summ found as before, *viz.* $\frac{19}{24}$ *l.* for (by the 5*th.* Rule of Chapter 19) the value of $\frac{19}{24}$ *l.* will be found to be 15 *s.* 10 *d.* and so will 15 *s.* $\frac{20}{24}$ be found to be just as much.

Quest. 9. What is the summ of $\frac{4}{5}$ *l.* $\frac{3}{8}$ *s.* and $\frac{3}{5}$ *d.* ? Answer, $\frac{379500}{600000}$ or $\frac{3795}{6000}$ *l.* or in its lowest Terms $\frac{253}{400}$.

CHAP.

CHAP. XXI.

Substraction of Vulgar Fractions.

1. THE Rules in Addition for reducing the given Fractions to one denomination are here to be observed; for before Substraction can be made, the Fractions must be reduced to a common Denominator; then substract one Numerator from the other, and place the remainder over the common Denominator, which Fraction shall be the excess or difference between the given Fractions. Example,

Quest. 1. What is the difference between $\frac{3}{4}$ and $\frac{5}{7}$? The given Fractions are redued to $\frac{21}{28}$ and $\frac{20}{28}$ then substract the Numerator 20 from the Numerator 21, and there remains 1, which being put over the Denominator 28, makes $\frac{1}{28}$ for the answer or difference between $\frac{5}{4}$ and $\frac{5}{7}$.

Quest. 2. What is the difference between $\frac{5}{6}$ and $\frac{3}{5}$ of $\frac{5}{8}$?

Reduce the compound Fraction $\frac{3}{5}$ of $\frac{5}{8}$ to a simple Fraction, then proceed as before and the Answer is $\frac{110}{240}$ equal to $\frac{11}{24}$.

2. When

2. When a Fraction is given to be substracted from a whole Number, substract the Numerator from the Denominator and put the remainder for a Numerator to the given Denominator, and substract an Unit (for that you borrowed) from the whole Number, and the remainder place before the Fraction found as before, which mixt Number is the remainder or difference sought. Example,

Quest. 3. Substract $\frac{7}{10}$ from 48.

Answer, $47\frac{3}{10}$; For if you substract 7 (the Numerator) from 10 (the Denominator,) there remains 3, which put over 10 is $\frac{3}{10}$ and 1 (I borrowed) from 48 rests 47, to which joyn $\frac{3}{10}$ and it makes $47\frac{3}{10}$ for the excess.

Quest. 4. Substract $\frac{13}{21}$ from 57, remains $56\frac{8}{21}$.

3. If it is required to substract a Fraction from a mixt Number, or one mixt Number from another, reduce the Fractions to a common Denominator, and if the Fraction to be substracted be lesser than the other, then substract the lesser Numerator from the greater, and that is a Numerator for the common Denominator; then substract the lesser Integral part from the greater, and the remainder with the remaining Fraction thereto annexed, is the difference required

required between the two given mixt Numbers. Example,

Quest. 5. Substract $26\frac{3}{7}$ from $54\frac{5}{6}$.

First substract $\frac{3}{7}$ *viz.* $\frac{18}{42}$ from $\frac{5}{6}$ *viz.* $\frac{35}{42}$, the remainder is $\frac{17}{42}$, then 26 from 54 remaineth 28, to which annex $\frac{17}{42}$, it makes $28\frac{17}{42}$ for the *Answer.*

4. But if the Fraction to be substracted is greater than the Fraction from whence you substract, then having first reduced the Fractions to a common Denominator, take the Numerator of the greatest Fraction out of the Denominator, and add the remainder to the Numerator of the lesser Fraction, and their summ is a new Numerator to the common Denominator, which Fraction note, then (for the Unit you borrowed) add 1 to the Integral part to be substracted, and substract it from the greater Number, and to the remainder annex the Fraction you noted before, so this new mixt Number shall be the difference sought. Example.

Quest. 6. Substract $14\frac{3}{4}$ from $29\frac{4}{7}$.

The Fractions reduced are, *viz.* $\frac{3}{4}$ equal to $\frac{21}{28}$, and $\frac{4}{7}$ equal to $\frac{16}{28}$, now I should substract $\frac{21}{28}$ from $\frac{16}{28}$, but I cannot, therefore I substract 21 from 28, rests 7, which added to 16 (the lesser Numerator) makes 23 for a Numerator to 28, *viz.* $\frac{23}{28}$, then I come to the Integral parts 14 and 29, and say 1 that I bor-

2. When a Fraction is given to be substracted from a whole Number, substract the Numerator from the Denominator and put the remainder for a Numerator to the given Denominator, and substract an Unit (for that you borrowed) from the whole Number, and the remainder place before the Fraction found as before, which mixt Number is the remainder or difference sought. Example,

Quest. 3. Substract $\frac{7}{10}$ from 48.

Answer, $47\frac{3}{10}$; For if you substract 7 (the Numerator) from 10 (the Denominator,) there remains 3, which put over 10 is $\frac{3}{10}$ and 1 (I borrowed) from 48 rests 47, to which joyn $\frac{3}{10}$ and it makes $47\frac{3}{10}$ for the excess.

Quest. 4. Substract $\frac{13}{21}$ from 57, remains $56\frac{8}{21}$.

3. If it is required to substract a Fraction from a mixt Number, or one mixt Number from another, reduce the Fractions to a common Denominator, and if the Fraction to be substracted be lesser than the other, then substract the lesser Numerator from the greater, and that is a Numerator for the common Denominator; then substract the lesser Integral part from the greater, and the remainder with the remaining Fraction thereto annexed, is the difference required

required between the two given mixt Numbers. Example,

Queſt. 5. Subſtract $26\frac{3}{7}$ from $54\frac{5}{6}$.

Firſt ſubſtract $\frac{3}{7}$ *viz.* $\frac{18}{41}$ from $\frac{5}{6}$ *viz.* $\frac{35}{42}$, the remainder is $\frac{17}{42}$, then 26 from 54 remaineth 28, to which annex $\frac{17}{42}$, it makes $28\frac{17}{42}$ for the *Anſwer*.

4. But if the Fraction to be ſubſtracted is greater than the Fraction from whence you ſubſtract, then having firſt reduced the Fractions to a common Denominator, take the Numerator of the greateſt Fraction out of the Denominator, and add the remainder to the Numerator of the leſſer Fraction, and their ſumm is a new Numerator to the common Denominator, which Fraction note, then (for the Unit you borrowed) add 1 to the Integral part to be ſubſtracted, and ſubſtract it from the greater Number, and to the remainder annex the Fraction you noted before, ſo this new mixt Number ſhall be the difference ſought. Example.

Queſt. 6. Subſtract $14\frac{3}{4}$ from $29\frac{4}{7}$.

The Fractions reduced are, *viz.* $\frac{3}{4}$ equal to $\frac{21}{28}$, and $\frac{4}{7}$ equal to $\frac{16}{28}$, now I ſhould ſubſtract $\frac{21}{28}$ from $\frac{16}{28}$, but I cannot, therefore I ſubſtract 21 from 28, reſts 7, which added to 16 (the leſſer Numerator) makes 23 for a Numerator to 28, *viz.* $\frac{23}{28}$, then I come to the Integral parts 14 and 29, and ſay 1 that I bor-

rowed and 14 is 15, which taken from 29, there rests 14, to which annexing $\frac{23}{28}$ it is 14 $\frac{23}{28}$ for the remainder or difference between $14\frac{3}{4}$ and $29\frac{4}{7}$.

Quest. 7. Substract $36\frac{9}{10}$ from $74\frac{4}{9}$ *Facit* $37\frac{49}{90}$.

CHAP. XXII.

Multiplication of Vulgar Fractions.

1. If the Multiplicand and Multiplier are simple (or single) Fractions, then multiply the Numerators together for a new Numerator, and the Denominators for a new Denominator, which new Fraction is the Product required.

Quest. 1. What is the Product of $\frac{5}{7}$ by $\frac{9}{11}$ *Facit* $\frac{45}{77}$.

For the Numerators 5 and 9 being multiplied, make 45, and the Denominators and 11 being multiplied make 77.

Quest. 2. What is the Product of $\frac{18}{23}$ by $\frac{21}{37}$ *Facit* $\frac{378}{451}$.

2.

2. If the Fractions to be multiplied are ixt Numbers, reduce them to improper ractions by the first Rule of the 19*th*. Chapter, then proceed as before.

Quest. 3. What is the Product of $28\frac{3}{5}$ by $3\frac{5}{6}$?

The given mixt Numbers being reduced o improper Fractions, are $48\frac{3}{5}$ equal to $\frac{243}{5}$, nd $13\frac{5}{6}$ equal to $\frac{83}{6}$, now $\frac{243}{5}$ multiplied by $\frac{83}{6}$ ccording to the first Rule of this Chapter, roduceth $\frac{20169}{30}$ or $672\frac{9}{30}$.

Quest. 4. What is the Product of $430\frac{6}{10}$ y $18\frac{3}{7}$? *Facit* $\frac{555474}{70}$ or $7935\frac{24}{70}$.

3. If a compound Fraction is to be muliplied by a simple Fraction, first reduce he compound Fraction into a simple Fraction, then multiply the one by the other s is taught above.

Quest. 5. What is the Product of $\frac{16}{21}$ by $\frac{3}{4}$ f $\frac{5}{7}$ of $\frac{4}{5}$? The compound Fraction $\frac{3}{4}$ of $\frac{5}{7}$ f $\frac{4}{5}$ reduceed is $\frac{60}{140}$ or $\frac{6}{14}$ which multiplied by produceth $\frac{96}{294}$ which in its lowest Term s $\frac{16}{49}$ for the Answer.

And if the Multiplicand and Multiplier re both compound Fractions, reduce them oth to simple ones, then multiply these ew Fractions as before, so have you the roduct.

Quest. 6. What is the Product of $\frac{3}{4}$ of $\frac{2}{8}$ y $\frac{3}{5}$ of $\frac{1}{2}$?

Answer, $\frac{18}{120}$ in its loweſt Terms $\frac{3}{20}$.

Queſt. 7. What is the Product of $\frac{3}{4}$ of by $\frac{2}{5}$ of $\frac{5}{8}$?

Anſwer, $\frac{60}{360}$ or $\frac{6}{36}$, or in its leaſt Terms $\frac{1}{6}$.

4. If a Fraction be to be multiplied by a whole Number, put under the given whole Number an Unit for a Denominator, where by it will be an improper Fraction, then multiply theſe Fracions as before. Example,

Queſt. 8. What is the Product of 24 by $\frac{2}{3}$?

Anſwer, $\frac{48}{3}$, for 24 by putting an Unit under it will be $\frac{24}{1}$, and $\frac{24}{1}$ by $\frac{2}{3}$ produceth $\frac{48}{3}$ or 16.

Queſt. 9. What is the Product of 36 by $\frac{9}{11}$? *Anſwer*, $\frac{324}{11}$ or $29\frac{5}{11}$.

C H A P. XXIII.

Diviſion of Vulgar Fractions.

1. IF the Dividend and the Diviſor are both ſimple Fractions, then multiply the Numerator of the Dividend into the Denominator of the Diviſor, and the Product is a new Nemerator, and multiply the Denominator of the Dividend into the Numerator

merator of the Divisor and the Product is a new Denominator, which new Fraction thus found, is the Quotient you desire. Example.

Quest 1. What is the Quotient of $\frac{5}{8}$ divided by $\frac{3}{5}$?

Answer, $\frac{25}{24}$ or $1\frac{1}{24}$, for first I multiply (5) the Numerator of the Dividend into (5) the Denominator of the Divisor, and the Product (25) is a Numerator for the Quotient, then I multiply (8) the Denominator of the Dividend into (3) the Numerator of the Divisor, and the Product (24) I put in the Quotient for a Denominator, so I find $\frac{25}{24}$ is the Quotient sought.

$$\frac{3}{5}\Big)\frac{5}{8}\Big(\frac{25}{24}$$

Quest 2. What is the Quotient of $\frac{10}{21}$ divided by $\frac{2}{3}$?

Answer, $\frac{30}{42}$ equal to $\frac{5}{7}$ in its lowest Terms.

But if you would divide a simple Fraction by a compound, or a compound by a simple, first reduce such compound to a simple Fraction, then go on as before.

Quest. 3. What is the Quotient of $\frac{3}{10}$ divided by $\frac{3}{4}$ of $\frac{2}{3}$?

Answer, $\frac{36}{60}$ or $\frac{3}{6}$. First reduce $\frac{3}{4}$ of $\frac{2}{3}$ into a simple Fraction and it is $\frac{6}{12}$, by which $\frac{3}{10}$ being divided, the Quotient is $\frac{36}{60}$ equal in its least Terms to $\frac{3}{6}$. And if the Dividend, and Divisor be both compound Fractions, reduce them both to a simple fraction, then divide the one

by the other, as in Rule 1 beforegoing.

Quest. 4. What is the Quote of $\frac{2}{3}$ of $\frac{3}{4}$ divided by $\frac{1}{5}$ of $\frac{5}{8}$?

Answer, $\frac{180}{120}$ or $\frac{18}{12}$ or $1\frac{6}{12}$ or $1\frac{1}{2}$ in its lowest Terms.

3. If the Dividend, or Divisor, or both, are mixt Numbers, reduce them to improper Fractions, and perform Division as you were taught before. Example,

Quest. 5. What is the Quote of $12\frac{3}{4}$ divided by $21\frac{4}{5}$?

Answer, $\frac{255}{436}$, for $12\frac{3}{4}$ is equal to $\frac{51}{4}$ and $21\frac{4}{5}$ is equal to $\frac{109}{5}$, and the Quote of $\frac{51}{4}$ divided by $\frac{109}{5}$ is as before, $\frac{255}{436}$

4. If you divide a Fraction by a whole Number, or a whole Number by a Fraction, make the whole Number an improper Fraction by putting an Unit for a Denominator to it as was taught in Rule 4 of Chapter 22, and then perform Division as before was taught. Example,

Quest. 6. What is the Quote of 8 divided by $\frac{3}{5}$?

Answer, $\frac{40}{3}$ which is equal to $13\frac{1}{3}$ being reduced as is before directed. See the Work in the Margent.

$$\frac{3}{5}\Big)\frac{8}{1}\Big(\frac{40}{3}\ \textit{or},\ 13\tfrac{1}{3}$$

Quest. 7. What is the Quotient of $\frac{3}{5}$ divided by 8? *Answer*, $\frac{3}{40}$, as *per* Margent.

$$\frac{8}{1}\Big)\frac{3}{5}\Big(\frac{3}{40}$$

CHAP.

CHAP. XXIV.

The Rule of Three Direct in Vulgar Fractions.

1. AS in the Rule of 3 in whole Numbers, ſo likewiſe in Fractions, you muſt ſee that the Fractions of the firſt and third places be of the ſame denomination.

2. See that if any of the given Fractions be compound, that they be reduced to ſimple of the ſame value.

3. If there are given mixt Numbers, reduce them to improper Fractions by the firſt Rule of Chapter 19.

4. If any of the three Terms is a whole Number make it an improper Fraction by conſtituting Unit for its Denominator.

Having reduced your Fraction as is directed in the four laſt Rules, then proceed to a reſolution, which is performed the ſame way as in whole Numbers, reſpect being had to the Rules delivered for the Working of Fractions, *viz.* multiply the 2*d.* and 3*d.* Fraction together according to the firſt

Rule of Chap. 22. and divide the Product by the first Fraction, according to the 1 Rule of Chap. 23. and the Quotient is the Answer.

Or (which is better)

5. Multiply the Numerator of the first Fraction into the Denominators of the second and third, and the Product is a new Denominator, then multiply the Denominator of the first Fraction into the Numerators of the second and third, and the Product is a new Numerator; which new Fraction is the *4th.* Proportional, or Answer, which (if it is an improper Fraction) must be reduced to a whole or mixt Number by the third Rule of Chapter 19. Examples.

Quest. 1. If $\frac{3}{4}$ Yards of Cloth cost $\frac{5}{8}$ *l.* what will $\frac{6}{10}$ Yards cost?

Having placed the given Fractions according to the *6th.* Rule of Chap. 10. I proceed to the Resolution; and first I multiply the Numerator of the first Fraction (3) into 8 and 10, the Denominators of the second and third Fractions, and the Product is 240 for a Denominator; then I multiply 4 the Denominator of the first Fraction into 5 and 9, the

$$\overset{yds.}{\frac{3}{4}} \quad \overset{l.}{\frac{5}{8}} \quad \overset{yds.}{\frac{9}{10}} \quad \overset{l.}{\frac{180}{240}}$$

$$\textit{Facit}\ \overset{l.}{\frac{180}{240}}\ \text{equal to}\ \overset{l.}{\frac{3}{4}}$$

the Numerators of the second and third Fractions, the Product is 180 for a Numerator, which Numerator 180 and Denominator 240 make $\frac{180}{240}$ *l.* for the Anſwer, equal to $\frac{3}{4}$ *l.* or 15 *s.*

Queſt. 2. If $\frac{2}{3}$ *l.* buy $\frac{5}{6}$ Yards of Cloth, what will $\frac{11}{12}$ Yards coſt at that rate?

Anſwer, $\frac{132}{180}$ *l.* equal to $\frac{11}{15}$ *l.* or 14 *s.* 8 *d.*

Queſt. 3. If $\frac{7}{8}$ *l.* coſt $\frac{3}{4}$ *s.* what will $\frac{8}{9}$ *s.* buy?

Anſwer, $\frac{224}{216}$ *l.* equal to 1 $\frac{1}{27}$ *l.*

Queſt. 4. If $\frac{3}{5}$ of an Ell of *Holland* coſt $\frac{1}{3}$ of a Pound, how much will 12$\frac{2}{3}$ Ells coſt at that rate?

Anſwer, $\frac{190}{27}$ equal to 7 $\frac{1}{27}$ *l.*

In reſolving the laſt Queſtion and the two next, obſerve the 3*d.* Rule of this Chapter foregoing.

Queſt. 5. If $\frac{9}{10}$ of a *C.* coſt 284 *s.* what will 7 $\frac{1}{2}$ *C.* coſt at that rate?

Anſwer, 239 $\frac{7}{12}$ *s.* or 11 *l.* 19 *s.* 7 *d.*

Queſt. 6. If 3 $\frac{1}{4}$ Yards of Velvet coſt 3 $\frac{5}{8}$ *l.* how much will 10$\frac{1}{2}$ Yards coſt at that rate?

Anſwer, 11 $\frac{37}{52}$ *l.*

Queſt. 7. If 3 Yards of broad Cloth coſt 2$\frac{4}{5}$ *l.* what will 14$\frac{3}{5}$ Yards coſt?

Anſwer, 13 *l.* 9 *s.* 4 *d.*

In working the laſt Queſtion and the 4*th.* next, obſerve the 4*th.* Rule of this Chapter foregoing.

Quest. 8. If 14 *l.* of Pepper cost 14 $6\frac{3}{5}$ *d.* I demand the price of $73\frac{3}{4}$ *l.*

Answer, 3 *l.* 16 *s.* $9\frac{41}{56}$ *d.*

Quest. 9. If 1 *l.* of Cochenele cost 1 *l.* 5 what will $36\frac{7}{10}$ *l.* cost?

Answer, 45 *l.* 17 *s.* 6 *d.*

Quest. 10. If one Yard of Broad-Clot cost $15\frac{5}{8}$ *s.* what will four pieces, each con taining $27\frac{3}{7}$ Yards at that rate?

Answer, 85 *l.* 14 *s.* $3\frac{3}{7}$ *d.*

Quest. 11. A Mercer bought $3\frac{1}{2}$ *pcs.* of sil each piece qt. $24\frac{2}{3}$ Ells at 6 *s.* $0\frac{3}{4}$ *d. per* Ell, demand the value of $3\frac{1}{2}$ *pcs.* at that rate?

Answer, 26 *l.* 3 *s.* $4\frac{3}{4}$ *d.*

In solving the four next Questions ob serve the 8 Rule of Chapter 19.

Quest. 12. If $\frac{2}{5}$ of an Ounce of Silver cos 2 *s.* I demand the price of $11\frac{2}{3}$ *l.* at tha rate?

Answer, 35 *l.*

Quest. 13. If $1\frac{5}{7}$ *l.* of Gold is worth $61\frac{5}{7}$ *l.* *Sterling*, what is 1 grain worth at tha rate?

Answer, $1\frac{1}{2}$ *d.*

Quest. 14. If $\frac{3}{4}$ Yards of Silk is worth of $\frac{5}{6}$ *l.* what is the price of $15\frac{2}{5}$ Ells *Flemish*

Answer, 9 *l.* 12 *s.* 6 *d.*

Quest. 15. If $\frac{2}{3}$ of $\frac{3}{4}$ of a pound of Clove cost 6 *s.* $2\frac{2}{7}$ *d.* what cost the C. weight at tha rate?

Answer, 69 *l.* 6 *s.* 8 *d.*

Note,

Note, that when the Anſwers to the Queſtions in this and the next Chapter are given in Fractions, they are given in the loweſt Terms.

CHAP. XXV.

The Rule of Three Inverſe in Fractions.

1. IT hath been already taught (in the 3*d.* Rule of the 11*th.* Chapter) how to diſcover when the 4*th.* proportional Number (to the three given Numbers) is to be found out by a Rule of Three Direct, and when by a Rule of Three Inverſe, to which Rule the Learner is now referred.

2. When (in Fractions) you find a Queſtion to be ſolved by the Rule of Three inverſe, *viz.* when the third Term is the Diviſor, then (having reduced the Terms exactly according to the Rules in Chapter 24.) multiply the Numerator of the three Fractions into the Denominators of the ſecond and firſt Fractions, and the Product is a new Denominator; then multiply the Denominator of the third Fraction into the Numerators

merators of the second and first Fractions, and the Product is a new Numerator, which new Fraction thus found is the Answer to the Question.

Quest. 1. If $\frac{3}{4}$ of a Yard of Cloth that is 2 Yards wide will make a Garment, how much of any other Drapery, that is $\frac{3}{5}$ of a Yard wide will make the same Garment?

Answer, $2\frac{1}{2}$ Yards.

Quest. 2. Lent my Friend 46 *l.* for $\frac{4}{5}$ of a Year, how much ought he to lend me for $\frac{7}{12}$ of a Year?

Answer, $63\frac{3}{5}$ *l.*

Quest. 3. If $\frac{2}{3}$ of a yard of Cloth that is $2\frac{1}{3}$ Yards wide will make any Garment, what breadth is that Cloth, when $1\frac{3}{4}$ Yards will make the same Garment?

Answer, $\frac{56}{63}$ of a Yard wide.

Quest. 4. How many Inches in length of a board that is 9 Inches broad, will make a Foot square?

Answer, 16 Inches in length.

Quest. 5. If when the Bushel of Wheat cost $4\frac{3}{4}$ *s.* the Penny Loaf weigheth $10\frac{1}{3}$ Ounces, what will it weigh when the Bushel cost $8\frac{9}{10}$ *s.*?

Answer, $5\frac{185}{267}$ Ounces.

Quest. 6. If 12 Men can mow $24\frac{1}{2}$ Acres in $10\frac{2}{3}$ Days, in how many Days will 6 Men do the same?

Answer, in $21\frac{1}{3}$ Days.

CHAP.

CHAP. XXVI.

Rules of Practice.

1. IN the Single Rule of Three when the first of the three Numbers in the Questions (after they are disposed according to the 6*th*. Rule of Chapter 10) happeneth to be an Unit, (or 1, that Question many times may be resolved far more speedily than by the Rule of Three, which kind of Operation is commonly called Practice, and indeed it is of excellent use amongst Merchants, Trades-men and others, by reason of its speedinefs in finding a Resolution to such kind of Questions.

2. The chiefest Question resolvable by these brief Rules may be comprehended under the seven general Heads or Cases following, *viz.*

When

When the given Price of the Integer consists	1 *Of Farthings under* 4. 2 *Of Pence under* 12. 3 *Of Pence and Farthings.* 4 *Of Shillings under* 20. 5 *Of Shill. Pence and Farthings.* 6 *Of Pounds.* 7 *Of Pounds, Shillings, Pence and Farthings.*

It would be very convenient for the practical Arithmetician, to have by heart the ſeveral Products of the nine Digits multitiplied by 12, for his ſpeedy reducing Pence into Shillings, or Shillings into Pence, which he may gain by the following Table.

12 Times	1	is	12
	2		24
	3		36
	4		48
	5		60
	6		72
	7		84
	8		96
	9		108

3. Shillings are practically reduced into Pounds thus, *viz.* cut off the Figure ſtanding in the place of Units with a daſh of the

Pen

Pen and note it for Shillings; then draw a Line under the given Number, and take half of the remaining Figures (after the first is cut off) and set them under the Line, and they are so many Pounds; but if the last Figure is odd, then take the lesser half and add 10 to the Figure so cut off (as before) for Shillings, as if I were to reduce 43658 Shillings into Pounds, first I cut off the last Figure (8) for Shillings, then I take half of the remaining Figures (43658) thus, half of 4 is 2, which I put under the Line, then $\frac{1}{2}$ of 3 is 1, and because 3 is an odd Number, I make the next Figure 6 to be 16, and I go on saying $\frac{1}{2}$ of 16 is 8, and then $\frac{1}{2}$ of 5 is 2, which is the last Figure, wherefore because 5 is an odd Number, I add 10 to the 8 I cut off and it makes 18 *s.* so that I find it to be 2182 *l.* 18 *s.* as *per* Margent.

4365	8
l.	*s.*
2182	18

4. It is likewise convenient that the Learner be acquainted with the Practical Tables following, the first containing the Aliquot (or even) parts of a Shilling, the second containing the Aliquot parts of a Pound.

The

The even parts of a Shilling.

d.		*s.*
6	is	$\frac{1}{2}$
4		$\frac{1}{3}$
3		$\frac{1}{4}$
2		$\frac{1}{6}$
$1\frac{1}{2}$		$\frac{1}{8}$
1		$\frac{1}{12}$

The even parts of a Pound.

s. — *d.*		*l.*
10—00	is	$\frac{1}{2}$
6—08		$\frac{1}{3}$
5—00		$\frac{1}{4}$
4—00		$\frac{1}{5}$
3—04		$\frac{1}{8}$
2—06		$\frac{1}{10}$
2—00		$\frac{1}{12}$
1—08		$\frac{1}{20}$
1—00		

Case 12.

5. When the price of the Integer is a Farthing, then take the ſixth part of the given Number, which will be ſo many three Half-pences, and if any thing remains it is Farthings, by the *7th.* Rule of Chapter 9, then conſider that three Half-pence is $\frac{1}{8}$ of a Shilling,

hilling, wherefore take the eighth part of hem for Shillings, and if any thing remain hey are so many three Half-pence, which educe into Pounds by the 3*d.* Rule foregoing. Example, What comes 67486 *l.* to t a Farthing *per l.* First, I take $\frac{1}{6}$ of 67486 nd it is 11247 three Half-pence and four arthings or one Penny; then $\frac{1}{8}$ of 11247 s 1405 *s.* and 7 remains, which is 7 three Half-pence or 10$\frac{1}{2}$ *d.* which with the four arthings before make 11$\frac{1}{2}$ *d.* and 1405 hillings, which by the 3*d.* Rule is 70 *l.* *s.* In all the 70 *l.* 5 *s.* 11$\frac{1}{2}$ *d.* for the Answer. See the Work following.

	d.
$\frac{1}{6}$	67486 *at* $\frac{1}{4}$ *per l.*
	d.
$\frac{1}{8}$	11247—1
$\frac{1}{20}$	140|5—10$\frac{1}{2}$
	l. *s.* *d.*
	70—5—11$\frac{1}{2}$ *Facit.*

Other

Other Examples follow.

$\frac{1}{6}$	857 *l.* at 1 *qrs.*
$\frac{1}{8}$	1429 — 2 *qrs.*
$\frac{1}{20}$	17|8 — 8 *d.*
	l. *s.* *d.*
	8 — 18 — 8 *facit.*

$\frac{1}{6}$	63801. at 1 *qrs.*
$\frac{1}{8}$	1063 — 2 *qrs.*
$\frac{1}{20}$	13|2 — 11 *d.*
	l. *s.* *d.*
	6 — 12 — 11 *fa*

6. When the price of the Integer is Farthings, then take the third part of th given Number for so many Half-pences, an the remainder (if any) is Half pence, the take the eighth part of that for Shillings as before, *&c.*

Examples,

$\frac{1}{3}$	7368 *l.* at 2 *qrs.*
$\frac{1}{8}$	2456
$\frac{1}{20}$	30|7
	l. *s.*
	15 — 7 *facit.*

3	8347 *l.* at 2 *qrs.*
$\frac{1}{8}$	2782 — 2 *qrs.*
$\frac{1}{20}$	34|7 — 9 *d.* $\frac{1}{2}$
	l. *s.* *d.*
	17 — 7 — $9\frac{1}{2}$ *facit*

7. When the price of the Integer is Farthings, then take half the given Numbe for three Half-pence, (and if any thin remain it is three Farthings) then take th eighth of that for Shillings as before, *&c.*

Examples

Examples,

$\frac{1}{2}$	4736 *l. at* 3 *qrs.*
$\frac{1}{8}$	2368
$\frac{1}{20}$	29|6
	l. *s.*
	14—16 *facit.*

$\frac{1}{2}$	5425 *l. at* 3 *qrs.*
$\frac{1}{8}$	2712 3 *qrs.*
$\frac{1}{20}$	33|9
	l. *s.* *d.* *qr.*
	16..19..0..3 *facit*

Case 2.

8. When the given price of the Integer, is a part, or parts of a Shilling (*viz.* Pence) divide the given Number of Integers (whose value is ſought) by the Denominator, of the Fraction repreſenting the even part, and the Quote is Shillings, (always minding the 7*th.* Rule of the 9*th* Chapter,) and thoſe Shillings may be reduced into Pounds by the 3*d* Rule of this Chapter. Example, Let it be required to find the value of 438 *l.* at 3 *d. per l.* I conſider 3 *d.* is $\frac{1}{4}$ of a Shilling, and 438 *l.* will coſt ſo many three Pences ; wherefore I divide 438 by 4 the Denominator of $\frac{1}{4}$, and the Quote is 109 Shillings, and 2 remains, which is 2 three Pences or 6 *d.* the whole value is 5 *l.* 9 *s.* 6 *d.* as by the following Work appeareth.

438 *l.*

$\frac{1}{4}$	438 *l.* at 3 *d.*
$\frac{1}{20}$	10|9 — 6

l. *s.* *d.*
Facit 5 — 9 — 6

More Examples follow.

	l. *d.*
$\frac{1}{2}$	3574 at 6 per *l.*
$\frac{1}{20}$	178|7

Facit 89 *l.* 7 *s.*

	l. *d.*
$\frac{1}{6}$	5316 at 2 per *l.*
$\frac{1}{20}$	88|6

Facit 44 *l.* 6 *s.*

	l. *d.*
$\frac{1}{3}$	438 at 4 per *l.*
$\frac{1}{20}$	4|6

Facit 7 *l.* 6 *s.*

	l. *d.*
$\frac{1}{8}$	6389 at $1\frac{1}{2}$ per *l.*
$\frac{1}{20}$	79|8 — 7 *d.* $\frac{1}{2}$

Facit 39 *l* 18 *s.* 7 *d.* $\frac{1}{2}$

	l. *d.*
$\frac{1}{4}$	879 at 3 per *l.*
$\frac{1}{20}$	21|9 — 9 *d.*

Facit 10 *l.* 19 *s.* 9 *d.*

	l. *d.*
$\frac{1}{4}$	818 at 1 per *l.*
$\frac{1}{20}$	6|8 — 2 *d.*

Facit 3 *l.* 8 *s.* *d.*

9. If

9. If the price of the Integer be Pence under 12, and yet not an even part, then it may be divided into even parts, and ſo the parts of the given Number taken accordingly, and added together, as if it were 5 *d.* which is 3 *d.* and 2 *d.* *viz.* $\frac{1}{4}$ and $\frac{1}{6}$ of a Shilling, firſt take $\frac{1}{4}$ of the given Number, and then $\frac{1}{6}$ thereof and add them together, and their ſumm is the Anſwer in Shillings, ſtill obſerving Rule 7 of Chapter 9. for the remainders, (if any be;) then bring the Shillings into Pounds by the third Rule foregoing. Likewiſe 7 *d.* is $\frac{1}{3}$ and $\frac{1}{4}$, ſo 9 *d.* is $\frac{1}{2}$ and $\frac{1}{4}$, and 10 *d.* is $\frac{1}{4}$ and $\frac{1}{4}$, and 11 *d.* is $\frac{1}{3}$ and $\frac{1}{3}$ and $\frac{1}{4}$ of a Shilling, or elſe many times your Work may be ſhortned thus, *viz.* when the ſaid given price is to be divided into even parts of a Shilling, or of a Pound, after you have taken the firſt even part, the other may be an even part of that part, as in the next Example, where is given 439 *l.* at 5 *d.* *per l.* now I may divide it thus, *viz.* into 4 *d.* and 1 *d.* and 4 *d.* being $\frac{1}{3}$ of a Shilling, and 1 *d.* being $\frac{1}{4}$ of 4 *d.* I firſt take $\frac{1}{3}$ of 439 *l.* and it gives 146 *s.* 4 *d.* and for the 1 *d.* I take $\frac{1}{4}$ of 146 *s.* 4 *d.* which is 36 *s.* 7 *d.* which in all comes to 9 *l.* 2 *s.* 11 *d.* Examples follow,

l. *d.*	*yds.* *d.*
439 *at* 5 *per l.*	417 *at* 9 *per yd.*
$\frac{1}{3}$ 146—4	$\frac{1}{2}$ 208—6
$\frac{1}{4}$ 36—7	$\frac{1}{2}$ 104—3
18|2—11	31|2—9
9 *l.* 2 *s.* 11 *d.* *Facit.*	15 *l.* 12 *s.* 9 *d. faci*
Ells. *d.*	*Ells.* *d.*
587 *at* 7 *per Ell.*	186 *at* 10
$\frac{1}{3}$ 195—8	$\frac{1}{2}$ 193
$\frac{1}{4}$ 146—9	$\frac{1}{3}$ 128—8
34|2—5	32|1—8
17 *l.* 2 *s.* 5. *Facit.*	16*l.* 01*s.* 8 *d. facit*
yds. *d.*	*l.* *d.*
836 *at* 8 *per Yard.*	534 *at* 11
$\frac{1}{3}$ 278—8	$\frac{1}{3}$ 178
$\frac{1}{3}$ 278—8	$\frac{1}{3}$ 178
	$\frac{1}{4}$ 133—6
55|7—4	48|9—6
27*l.* 17*s.* 4 *d. facit*	24 *l.* 9 *s.* 6 *d. facit*

Case 3.

Case 3.

10. When the price of the Integer is nce and Farthings, if it make an even rt of a Shilling, work as before, but if ey are uneven, as Penny-farthing, Penny-ree-farthings, 2 *d.* 1 *qrs.* or 2 *d.* 3 *qrs.* *d.* 3 *qrs.* or the like, then first work for me even part, and then consider what part e rest is of that even part, and divide that uotient thereby, then add them together nd reduce them to Pounds as before. Ex-mple, 4470 *l.* at 1 *d.* 1 *qrs.* *per l.* first I Vork for the Penny by dividing 3470 by 2, for 1 *d.* is $\frac{1}{12}$ of a hilling, and the Quote s 289 *s.* 2 *d.* then I conceive that 1 Farthing is of a Penny, and the Value at 1 Farthing, will be $\frac{1}{4}$ of the Value at 1 Penny, and therefore I take $\frac{1}{4}$ of 289 *s.* 2 *d.* which is 72 *s.* 3 *d.* 2 *qrs.* and add them together and they are 18 *l.* 1 *s.* 5 *d.* 2 *qrs.* as by the Margent. Other Examples of the same nature follow,

l.	*qrs.*
3470	at 5
289—2	
72—3—2	
36|1—5—2	

l.	*s.*	*d.*	*qrs.*
18	1	5	2

$\frac{1}{12}$ $\frac{1}{4}$
l. *d.*
4360 *at* $1\frac{1}{4}$
363 — 4
90 — 10
45|4 -- 2
l. *s.* *d.*
22 14 2 *facit*

$\frac{1}{6}$ $\frac{1}{8}$
485 *l. at* $2\frac{1}{4}$ *d.*
80 —— 10 *d.*
10 —— $1\frac{1}{4}$
9|0 —— $11\frac{1}{4}$
4 *l.* 10 *s.* $11\frac{1}{4}$ *d.*

$\frac{1}{6}$ $\frac{1}{4}$
654 *l. at* $2\frac{1}{2}$ *d.*
109
27 — 3 *d.*
13|6 — 3
6 *l.* 16 *s.* 3 *d.*

$\frac{1}{8}$ $\frac{1}{6}$
yds. *d.*
573 *at* $1\frac{3}{4}$
71 — $7\frac{1}{2}$ *d.*
11 — $11\frac{1}{4}$
8|3 — $6\frac{3}{4}$
l. *s.* *d.*
facit 4 — 3 -- $6\frac{3}{4}$

$\frac{1}{2}$ $\frac{1}{4}$
520 *yds. at* $7\frac{1}{2}$
260
65
32|5
16 *l.* 5 *s.* *facit*

$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{8}$
137 *yds. at* $10\frac{1}{2}$ *d.*
68 —— 6 *d.*
34 —— 3
17 —— $1\frac{1}{2}$
11|9 —— $10\frac{1}{2}$ *d.*
5 *l.* 19 *s.* $10\frac{1}{2}$ *d. facit*

Case 4.

Case. 4.

11. When the price of the Integer is 2 s. then cut off the Figure in the place of Units of the given Number, and double it for Shillings, and the Figures on the other hand are Pounds. Example, 436 yds. at 2 s. per yd. cut off the last Figure 6, and double it, it makes 12 Shillings; and the other 2 Figures, viz. 43, are so many Pounds; so that their value is 43 l. 12 s. as per Margent.

43|6

43 l. 12 s.

12. Hence it is evident, that when the given price of an Integer is an even Number of Shillings; then if you take half of that (even) Number of Shillings, and multiply the given Number of Integers thereby, doubling the first Figure of the Product, and setting it apart for Shillings, the rest of the Product will be Pounds, which Pounds and Shillings are the value sought. Example, what cost 536 yds. at 8 s. per yd? To resolve which, I take ½ of 8 s. (the price of a yd.) which is 4, and multiply 536 thereby, saying, 4 times 6 is 24; then I double the first Figure, 4 makes 8 for Shillings, and carry 2 to the next Product, &c.

536 yds. at 8 s.

214 l. 8 s.

O I find

I find the rest of the Product to be 214, which I note for Pounds; so the value of 536 *yds.* at 8 *s. per yd.* is 214 *l.* 8 *s.* as *per* Margent. More Examples follow.

56 *yds. at* 6 *s. per yd.*	420 *yds. at* 12 *s. per yd.*
16 *l.* 16 *s. facit.*	252 *l. facit.*
123 *yds. at* 4 *s. per yd.*	326 *yds. at* 14 *s. per yd.*
24 *l.* 12 *s. facit.*	228 *l.* 4 *s. facit.*
48 *ells at* 8 *s. per ell.*	48 *yds. at* 16 *s. per yd.*
19 *l.* 4 *s. facit.*	38 *l.* 8 *s. facit.*
84 *yds. at* 10 *s. per yd.*	52 *yds. at* 18 *s. per yd.*
42 *l. facit.*	46 *l.* 16 *s. facit.*

13. If the given price of the Integer is an odd Number of Shillings; then work first for the even Number of Shillings by the last Rule; and for the odd Shilling, take $\frac{1}{20}$ of the given Number of Integers, according to the third Rule of this Chapter, and add them together, and you have your desire. Examples follow.

yds. s.		ells s.	
422 at 3 per yard		431 at 13	
l.	s.	l.	s.
42	4	258	12
21	2	21	11
63	6 *facit.*	280	03 *facit.*

ells s.		ells s.	
516 at 7 per ell		324 at 17 per ell.	
l.	s.	l.	s.
154	16	259	4
25	16	16	4
180	12 *facit.*	275	8 *facit.*

14. Except when the given price of the Integer is 5 *s.* for then it is sooner answered, by taking $\frac{1}{4}$ of the given Number, whose value is sought, as in the following Example.

	yds. s.		ells s.
$\frac{1}{4}$	436 at 5 per yard	$\frac{1}{4}$	206 at 5 per ell.
	109 *l. facit.*		51 *l.* 10 *s. facit.*

Case 5.

15. When the given price of an Integer is Shillings and Pence, or Shillings, Pence and Farthings; then, if the Shillings and Pence be an even part of a Pound, divide the given Number of Integers, whose value you seek, by the Denominator of that Fraction representing that even part. As for Example, what is the price of 384 *yds.* at 6 *s.* 8 *d. per yd*? Here I consider that 6 *s.* 8 *d.* is $\frac{1}{3}$ of a Pound; wherefore I divide 384 by 3, and the quote is the Answer, *viz.* 128 *l.* so that 384 *yds.* at 6 *s.* 8 *d. per yd.* amounts to 128 *l.* as *per* margent, still observing the 7th Rule of the 9th Chapter.

$\frac{2}{0}$	384
	128 *l. facit.*

More Examples follow.

$\frac{1}{3}$	438 *ells at* 6 *s.* 8 *d.*	$\frac{1}{8}$	443 *yds. at* 2 *s.* 6 *d.*
	146 *l. facit*		55 *l.* 7 *s.* 6 *d. facit*
$\frac{1}{6}$	525 *at* 3 *s.* 4 *d.*	$\frac{1}{12}$	726 *yds. at* 1 *s.* 8 *d.*
	87 *l.* 10 *s. facit*		60 *l.* 10 *s. facit.*

16. Whe

16. When the given value of the Integer is Shillings and Pence, and not an even part of a pound; yet many times it may be divided into parts, (*viz.* 6 *s.* 6 *d.* is 4 *s.* and 2 *s.* 6 *d.* for the 4 *s.* work according to the 12 Rule foregoing, and for the 2 *s.* 6*d.* take the eighth part of the given Number, and add them together; then their Sum is the value required.)

So 8 *s.* 6 *d.* will be divided into 6 *s.* and 2 *s.* 6 *d.* and the price of the given Number may be found out as before, *&c.* Examples follow.

	yds.	*s.*	*d.*
	386 *at* 8—8		
1	128 *l.* 13—4		
3. 1/10	38 - 12—0		
	167 *l.* 5 *s.* 4 *d. fac.*		

	ells	*s.*	*d.*
s.	540 *at* 5—4		
2	54 *l.* 0 *s.*		
1/6	90 —— 0		
	144 *l.* 0 *s. facit.*		

	ells.	*s.*	*d.*
	427 *at* 8—6		
s. 6	128 *l* 2—0		
1/8	53 — 7—6		
	181 *l.* 9 *s.* 6 *d. fac.*		

	yds.	*s.*	*d.*
s.	386 *at* 14—8		
8	154 *l.* 8—0		
1/3	128—13—4		
	283 *l.* 1 *s.* 4 *d. facit.*		

17. When the given price of the Integer is Shillings and Pence, and you cannot readily divide them according to the last

Rule; then multiply the given Number, whose value you seek, by the Number of Shillings in the price of the Integer, and then for the Pence, work by the 8th Rule foregoing; then add the Numbers together, and their summ is the value sought in Shillings; as for Example, what is the value of 392 *yds.* at 6 *s.* 9 *d. per yard*? Here 6 *s.* 9 *d.* cannot be made any even part, nor indeed can it be divided into even parts of a Pound; wherefore I multiply the given Number of Yards 392 by 6; for the 6 *s.* the Product is 2352 Shillings; then for the 9 *d.* I divide it into 6 *d.* and 3 *d.* and work for them by the 8th Rule foregoing, and at last add the Shillings together, they make 2646 *s.* and by the third Rule they are reduced to 132 *l.* 6 *s.* the value of 392 *yds.* at 6 *s.* 9 *d. per yard.* See the Work following.

	yds.	*s.*	*d.*
	392 *at*	6	9
	2352		
½	196		
¼	98		
	264|6		
	132 *l.* 6 *s.* *facit.*		

Other

Other Examples follow.

	l.	s.	d.		ells	s.	d.
s.	480 at	4 —	10	s.	732 at	12 —	7
4	1920			12	8784		
1/2	240			1/3	244		
1/3	160			1/4	183		
	232|0				921|1		
	116 *l. facit.*				460 *l.* 11 *s. facit.*		

18. When the given price of the Integer is Shillings, Pence, and Farthings; then multiply the given Number of Integers by the Number of Shillings contained in the value of the Integer, and for the Pence and Farthings, follow the 10th Rule of this Chapter.

Examples.

	yds.	s.	d.
s	458 at	8 —	$6\frac{3}{4}$
8	3504		
$\frac{1}{2}$	219		
$\frac{1}{8}$	27 —		$4\frac{1}{2}$ d.
	375 | 0 —		$4\frac{1}{2}$
	fac. 187 *l.*	10 *s.*	$4\frac{1}{2}$ *d.*

	ells	s.	d.
	370 at	14 —	$2\frac{3}{4}$
	1480		
s.	370		
14	5180		d.
$\frac{1}{6}$	61 —		8
$\frac{1}{4}$	15 —		5
$\frac{1}{2}$	7 —		$8\frac{1}{2}$
	526 | 4 —		$9\frac{1}{2}$
	fac. 263 *l.*	4 *s.*	$9\frac{1}{2}$ *d.*

	ells	s.	d.
s.	136 at	9 —	$2\frac{1}{2}$
9	1224 —		0 d.
$\frac{1}{6}$	22 —		8
$\frac{1}{4}$	5 —		8
	125 | 2 —		4
	facit 62 *l.*	12 *s.*	4 *d.*

	ells	s.	d.
s.	431 at	2 —	$4\frac{1}{2}$
2	862		
$\frac{1}{4}$	107 —		9 d.
$\frac{1}{8}$	53 —		$10\frac{1}{2}$
	102 | 3 —		$7\frac{1}{2}$
	facit 51 *l.*	3 *s.*	$7\frac{1}{2}$ *d.*

Case 6.

19. When the given value of the Integer is Pounds; then multiply the Number of Integers, whose Value is sought by the price of the Integer, and the Product is the Answer in Pounds.

Examples

Examples.

C. *l.* 42 *at* 2 *per* C. 48 *l. facit.*	C. *l.* 13 *at* 8 *per* C. 104 *l. facit.*
C. *l.* 30 *at* 3 *per* C. 90 *l. facit.*	C. *l.* 48 *at* 12 *per* C. 576 *l. facit.*

Case 7.

20. If the price of the Integer is Pounds and Shillings; then for the Pounds work as in the last Rule, and for the Shillings as in the 12 and 13 Rules beforegoing; then add the Numbers produced from them both, and the Summ is the value sought.

Examples.

	C.	l.	s.
	46 *at*	2 —	4
2 l.	92		s.
4 s.	9 —		4
	101 l. 4 s. *facit.*		

	gross	l.	s.
	58 *at*	3 —	7
3 l.	174		s.
6 s.	17 —		8
1 s.	2 —		18
	194 l. 6 s. *facit.*		

	gross	l.	s.
	82 *at*	4 —	10
4 l.	328		
10 s.	41		
	369 l. *facit.*		

	gross	l.	s.
	26 *at*	3 —	15
3 l.	78		s.
14 s.	18 —		4
1 s.	1 —		6
	97 l. 10 s. *facit.*		

21. When the given price of an Integer consists of Pounds, Shillings and Pence, with Farthings; then work for the Shillings, Pence, and Farthings first, according to the 18th Rule of this Chapter, and find the total value of the given Number, as if there were no Pounds; then work with the pounds according to the 19th Rule of this Chapter, and add the Numbers thus found, and their summ is the total value required.

Examples

Examples of this Rule follow.

```
        C.        l.  s.  d.
        213 at 1--13--4½
        639
        213
13 s.   2769          d.
3 d.      53 ——————— 3
1½ d.     26 ——————— 7½
        284|8 ——— 10½
1 l.    142 l. 08 s. 10½ d.
        213
        355 l. 8 s. 10½ d. facit
```

```
C.       l.  s.  d.
37 at 3--8--10½
296 d      | 8 s.
  18--6    | 6 d.
   9--3    | 3 d.
   4--7½   | ½ d.
32|8-4½
 16 l. 8 s. 4½ d
111        | 3 l.
127 l. 8 s. 4½ d. fac.
```

```
        gross    l.  s.  d.
        416 at 2--9--3¾
9 s.    3744
3 d.     104
¾ d.      26
        387|4
        193 l. 14 s.
2 l.    832
        1025 l. 14 s. facit
```

```
gross     l.  s.  d.
48 at 3--15--11½
240
48
720      | 15 s.
 24      | 6 d.
 16      | 4 d
  6      | 1½ d.
76|6
 38--6
144      | 3 l.
182 l. 6 s. facit.
```

22. When

22. When there is given the value of an Integer, and it is required to know the value of many such Integers together, with $\frac{1}{4}$ or $\frac{1}{2}$ or $\frac{3}{4}$ of an Integer; then first (by the former Rules) find out the value of the given Number of Integers; and then for $\frac{1}{4}$ of an Integer take $\frac{1}{4}$ of the given value of the Integer, or for $\frac{1}{2}$, take $\frac{1}{2}$ of the given value of the Integer, and for $\frac{3}{4}$ first take $\frac{1}{2}$ of the given value, and then $\frac{1}{2}$ of that $\frac{1}{2}$, setting each part under the precedent; then adding them together, their Summ will be the required value of the Integers, and their parts. Example; what is the value of 116 $\frac{1}{2}$ *yds. at* 4 *s.* 6 *d. per yard?* To give an Answer, first I work for the value of 116 *yds.* by the 15th Rule foregoing, and then for the $\frac{1}{2}$ Yard I take $\frac{1}{2}$ of 4 *s.* 6 *d.* which is 2 *s.* 3 *d.* and add to the rest found as before; then is that Summ the value of 116 $\frac{1}{2}$ *yds.* at 4 *s.* 6 *d. per yard,* which I find to amount to 26 *l.* 04 *s.* 3 *d.* as by the Work in the Margent.

yds.	*s.*	*d.*
116$\frac{1}{2}$ *at*	4 —	6
11 *l.* 12 *s.*		2 *s.*
14 — 10 *d.*		2 *s* 6 *d.*
2 — 3		$\frac{1}{2}$ *yd.*
26 — 04 — 3 *facit.*		

Other

Other Examples follow.

$324\frac{1}{4}$ *yds. at* 4 *s* 10 *d.*	
1296 ——	4 *s.*
162 ——	6 *d.*
108 ——	4 *d*
1 — $2\frac{1}{2}$ *d*	$\frac{1}{2}$ *yd.*
156|7 *s.* — $2\frac{1}{2}$ *d.*	
78 *l.* 7 *s.* $2\frac{1}{2}$ *d. facit.*	

$720\frac{1}{2}$ *yds. at* 6 *s.* 8 *d.*

240 *l.* 3 *s.* 4 *d. fac.*

$228\frac{3}{4}$ *ells at* 12 *s.* 11 *d.*	
2736 ——	12 *s.*
76 ——	4 *d.*
76 ——	4 *d*
57 ——	3 *d.*
6 — $5\frac{1}{2}$ *d.*	$\frac{1}{2}$ *ell.*
3 — $2\frac{3}{4}$ *d.*	$\frac{1}{4}$ *ell.*
295|4 — $8\frac{1}{4}$ *d.*	
147 *l.* 14 *s.* $8\frac{1}{4}$ *d. facit.*	

C. qrs. l.	*l. s.*
28--3--14 *at*	1-10 *per C.*
28 *l.* ——	1 *l.*
14 *l.* ——	10 *s.*
00-15 *s.* —	$\frac{1}{2}$ *C.*
7 *s.* 6 *d.*	$\frac{1}{4}$ *C.*
3 *s.* 9 *d.*	14 *l*
43 *l.* 6 *s.* 3 *d. facit.*	

Many more Queſtions may be ſtated, and ſeveral other Rules of Practice may be ſhewn according to the method of divers Authors, but what have been delivered here are ſufficient for the practical Arithmetician in all Caſes whatſoever.

CHAP.

CHAP. XXVII.

The Rule of Barter.

1. BArter is a Rule amongst Merchants, which (in the Exchanging of one Commodity for another) informs them so to proportion their rates as that neither may sustain loss.

2. To resolve Questions in Barter, it will not be difficult to him that is acquainted with the Golden Rule, or Rule of Three, it being altogether used in resolving such Questions.

Quest. 1. Two Merchants (*viz.* A and B) Barter, A hath 13 *C.* 3 *qrs.* 14 *l.* of Pepper at 2 *l.* 16 *s. per C.* and B hath Cotton at 9 *d. per l.* I demand how much Cotton B must give A for his Pepper?

Answer, 9 *C.* 1 *qr.*

First, I find by the Rule of Three, or the Rules of Practice foregoing, how much the Pepper is worth, saying,

If 1 *C.* cost 2 *l.* 16 *s.* what will 13 *C.* 3 *qrs.* 14 *l.* cost?

Answer, 38 *l.* 17 *s.*

Secondly,

Secondly, by the Rule of Three say, if 9 *d.* buy 1 *l.* of Cotton, how much will 38 *l.* 17 *s.* buy?

Answer, $9\frac{1}{4}$ *C.* and so much Cotten must B give to A for 13 *C.* 3 *qrs.* 14 *l.* of Pepper at 2 *l.* 16 *s.* *per Cent.* when the Cotton is worth 9 *d.* *per l.*

Quest. 2. Two Merchents (A and B) Barter, A hath Ginger worth 1 *l.* 17 *s.* 4 *d.* *per C.* but in Barter he will have 2 *l.* 16 *s.* *per C.* B hath Nutmegs worth 5 *l.* 12 *s.* *per C.* now I demand how B must rate his Nutmegs *per C.* to make his gain in Barter equal to that of A?

Answer. 8 *l.* 8 *s.*

Say, by the Rule of Three, if 1 *l.* 17 *s.* 4 *d.* require 2 *l.* 16 *s.* in Barter, what will 5 *l.* 12 *s.* require in Barter?

Facit, 8 *l.* 8 *s.*

Quest. 3. A and B Barter; A hath 120 Yards of Broad-cloth worth 6 *s.* *per Yd.* but in Barter he will have 8 *s.* *per Yd.* B hath Shalloon worth 4 *s* *per Yd.* Now I demand how many Yards of Shalloon B must give A for his Broad-cloth, making his gain in Barter equal to that of A?

Answer, 180 Yards of Shalloon.

First, (as in the last Question) find out how B ought to sell his Shalloon in Barter, *viz.* say, If 6 *s.* require 8 *s.* what will 4 *s.* require? *Answer*,

CHAP. XXVII.

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Answer, 9 *C.* 1 *qr.*

First, I find by the Rule of Three, or the Rules of Practice foregoing, how much the Pepper is worth, saying,

If 1 *C.* cost 2 *l.* 16 *s.* what will 13 *C.* 3 *qrs.* 14 *l.* cost?

Answer, 38 *l.* 17 *s.*

Secondly,

Secondly, by the Rule of Three say, if 9 *d.* buy 1 *l.* of Cotton, how much will 38 *l.* 17 *s.* buy?

Answer, $9\frac{1}{4}$ *C.* and so much Cotten must B give to A for 13 *C.* 3 *qrs.* 14 *l.* of Pepper at 2 *l.* 16 *s. per Cent.* when the Cotton is worth 9 *d. per l.*

Quest. 2. Two Merchants (A and B) Barter, A hath Ginger worth 1 *l.* 17 *s.* 4 *d. per C.* but in Barter he will have 2 *l.* 16 *s. per C.* B hath Nutmegs worth 5 *l.* 12 *s. per C.* now I demand how B must rate his Nutmegs *per C.* to make his gain in Barter equal to that of A?

Answer. 8 *l.* 8 *s.*

Say, by the Rule of Three, if 1 *l.* 17 *s.* 4 *d.* require 2 *l.* 16 *s.* in Barter, what will 5 *l.* 12 *s.* require in Barter?

Facit, 8 *l.* 8 *s.*

Quest. 3. A and B Barter, A hath 120 Yards of Broad-cloth worth 6 *s. per Yd.* but in Barter he will have 8 *s. per Yd.* B hath Shalloon worth 4 *s per Yd.* Now I demand how many Yards of Shalloon B must give A for his Broad-cloth, making his gain in Barter equal to that of A?

Answer, 180 Yards of Shalloon.

First, (as in the last Question) find out how B ought to sell his Shalloon in Barter, *viz.* say, If 6 *s.* require 8 *s.* what will 4 *s.* require? *Answer*,

Answer, 5 *s.* 4 *d.*

Thus you see that B must sell his Shalloon in Barter at 5 *s.* 4 *d.* if A sell his Broadcloth at 8 *s. per* Yard.

It remaineth now to find how much Shalloon B must give for 120 Yards of Broadcloth, which, after the same method used to resolve the first Question of this Chapter, is found to be 180, and so many Yards of Shalloon must B give A for the 120 Yards of Broad cloth.

Quest. 4. A and B bartered, A had 14 *C.* of Sugar worth 6 *d. per l.* for which B gave him 1 *C.* 3 *qrs.* of Cinnamon, I demand how B rated his Cinnamon *per l.*?

Answer, 4 *s. per* Pound.

Quest. 5. A and B Barter, A hath 4 Tun of Brandy worth 37 *l.* 16 *s.* ready Money, but in Barter he hath 50 *l.* 8 *s. per* Tun, and A giveth B 21 *C.* 2 *qrs.* 11$\frac{1}{5}$ *l.* of Ginger for his 4 Tun of Brandy, I desire to know how B sold his Ginger in Barter *per C.* and how much it was worth in ready Money?

Answer, For 9 *l.* 6 *s.* 8 *d.* in Barter, and it was worth 7 *l. per C.* in ready Money.

Quest. 6. A and B Barter, A hath 320 dozen of Candles at 4 *s.* 6 *d. per* dozen, for which B giveth him 30 *l.* in Money, and the rest in Cotton at 8 *d. per l.* I demand how much Cotton he must give him more than the 30 *l.*?

Answer,

Answer, 11 *C.* 1 *qr.*

Quest. 7. A and B Barter, A hath 608 Yards of Broad-cloth worth 14*s. per* Yard, for which B giveth him 125 *l.* 12 *s.* ready Money, and 85 *C.* 2 *qrs.* 24 *l.* of Bees Wax, now I desire to know how he reckoned his Wax *per C.* ?

Answer, 3 *l.* 10 *s. per C.*

CHAP. XXVIII.

Questions in Loss and Gain.

Quest. 1. A Merchant bought 436 Yards of Broad-cloth for 8 *s.* 6 *d. per* Yard, and selleth it again at 10 *s.* 4 *d. per* Yard, now I desire to know how much he gained in the Sale of the 436 Yards?

Answer, 39 *l.* 19 *s.* 4 *d.*

First, find out by the Rule of Three, or by Practice how much the Cloth cost him at 8 *s.* 6 *d. per* Yard, which I find to be 185 *l.* 6 *s.* then by the same Rule find out how much he sold it for, *viz.* 225 *l.* 5 *s.* 4 *d.* then

then subtract 185 *l.* 6 *s.* which it cost him, from 225 *l.* 5 *s.* 4 *d.* which he sold it for, and there remaineth 39 *l.* 19 *s.* 4 *d.* for his gain in the Sale thereof.

Otherwise it may sooner be resolved thus: First find out how much he gained *per* Yard, *viz.* subtract 8 *s.* 6 *d.* which he gave *per* Yard, from 10 *s.* 4 *d.* which he sold it for *per* Yard, the remainder is 1 *s.* 10 *d.* for his gains *per* Yard; then say,

If one Yard gain 1 *s.* 10 *d.* what will 436 Yards gain? The *Answer* by Practice, or the Rule of Three, is 39 *l.* 19 *s.* 4 *d.* as was found before.

Quest. 2. A Draper bought 124 Yards of *Holland* Cloth, for which he gave 31 *l.* I desire to know how he must sell it *per* Yard to gain 10 *l.* 6 *s.* 8 *d.* in the whole sale of the 124 Yards? *Answer*, at 6 *s.* 8 *d. per* Yard.

Add the price which it cost him (*viz.* 31 *l.*) to his intended gain (*viz.* 10 *l.* 6 *s.* 8 *d.*) the summ is 41 *l.* 6 *s.* 8 *d.* then say,

If 124 Yards require 41 *l.* 6 *s.* 8 *d.* what will 1 Yard require? By the Rule of Three I find the *Answer* 6 *s.* 8 *d.*

Quest. 3. A Grocer bought 3 *C.* 1 *qr.* 14 *l.* of Cloves, which cost him 2 *s.* 4 *d.* *per l.* and sold them for 52 *l.* 14 *s.* I desire to know how much he gained in the whole? *Answer*, 8 *l.* 12 *s.*

Quest. 4.

Quest. 4. A Draper bought 86 Kerseys for 129 *l.* I demand how he must sell them per piece to gain 15 *l.* in laying out 100 *l.* at that rate? *Answer*, 1 *l.* 14 *s.* 6 *d. per* piece; for,

As 100 *l.* is to 115 *l.* so is 129 *l.* to 148 *l.* 7 *s.*

So that by the proportion above, I have found how much he must receive for the 86 Kerseys, to gain after the rate of 15 *l. per C.* then to find how he must sell them *per* piece, I say,

As 86 pieces are to 148 *l.* 7 *s.* so is 1 piece to 1 *l.* 14 *s.* 6 *d.* which is the Number sought.

Quest. 5. A Grocer bought $4\frac{1}{4}$ *C.* of Pepper for 15 *l.* 17 *s.* 4 *d.* and (it proving to be damnified) is willing to lose 12 *l.* 10 *s. per Cent.* I demand how he must sell it *per l.*? *Answer*, 7 *d. per l.*

Subtract 12 *l.* 10 *s.* the loss of 100 *l.* from 100 *l.* and there remains 87 *l.* 10 *s.* then say,

As 100 *l.* is to 87 *l.* 10 *s.* so is 15 *l.* 17 *s.* 4 *d.* to 13 *l.* 17 *s.* 8 *d.* so much as he must sell it all, for to lose after the rate propounded: then to know how he must sell it *per l.* I say,

As 13 *l.* 17 *s.* 6 *d.* is to $4\frac{1}{4}$ *C.* so is 1 *l.* to 7 *d.*

Quest. 6.

Quest. 6. A *Plummer* sold 10 Fodder of Lead (the *fodder* containing $19\frac{1}{2}$C.) for 204 l. 15 s. and gained after the rate of 12 l. 10 s. per 100 l. I demand how much it cost him *per C.*? Answer 18 s. 8 d.

To resolve this Question, add 12 l. 10 s. (the Gain *per Cent.*) to 100 l. and it makes 112 l. 10 s. then say,

As 112 l. 10 s. is to 100 l. so is 204 l. 15 s. to 182 l.

Which 182 l. is the summ it cost him in all, then reduce your 10 Fodders to half hundreds, and it makes 390, then say,

As 390 half hundreds is to 182 l. so is 2 half hundreds to 18 s. 8 d. the price of 2 half hunSreds, or one C. weight, and so much it stood him in *per C.* weight.

Quest. 7. A Merchant bought 8 Tuns of Wine, which being sophisticated he selleth for 400 l. and looseth after the rate of 12 l. in receiving 100 l. now I demand how much it cost him *per Tun*? And how he selleth it *per Gallon* to lose after the said rate? *Answer*, it cost 56 l. *per Tun*, and he must sell it at 3 s. 11 d 2 $\frac{10}{21}$ *qrs. per Gallon* to lose 12 l. in receiving 100 l.

To resolve this Question I consider in the first place, that in receiving 100 l. he loseth 12 l. therefore 100 comes in, for 112 l. laid out, wherefore to find how much he laid out for the whole, I say,

As

As 100 *l.* is to 112, ſo is 400 *l.* to 448 *l.* and ſo much the 8 Tun coſt him; then to find how much it coſt *per* Tun, I ſay,

A 8 is to 448 *l.* ſo is 1 to 56 *l.* the price coſt *per* Tun.

Now to find how he muſt ſell it *per* Gallon, reduce the 8 Tuns into Gallons, they make 2016, then ſay,

As 2016 Gallons is to 400 *l.* ſo is one Gallon to 3 *s.* 11 *d.* $2\frac{10}{11}$ *qrs.* the price he muſt ſell it at *per* Gallon to loſe as aforeſaid.

Queſt. 8. A Merchant bought 8 Tuns of Wine, which being ſophiſticated he is willing to ſell for 400 *l.* and loſeth at that rate 12 *l.* in laying out 100 *l.* upon the ſame, now I demand how much it coſt him *per* Tun?

Here I conſider, that for 100 *l.* laid out, he receiveth but 88 *l.* therefore to find what the 8 Tuns coſt him, I ſay,

As 88 *l.* is to 100 *l.* ſo is 400 *l.* to $454\frac{6}{11}$ the price it all coſt him; then to find how much *per* Tun, I ſay,

As 8 is to $454\frac{6}{11}$ *l.* ſo is 1 to $56\frac{9}{11}$, or 56 *l.* 16 *s.* 4 *d.* $1\frac{5}{11}$ *qr.* *per* Tun.

CHAP.

CHAP. XXIX.

Equation of Payments.

1. EQuation of Payments, is that Rule amongst Merchants whereby we reduce the times for payment of several summs of Money, to an equated time for the payment of the whole Debt, without damage to Debtor or Creditor, and

The Rule is,

2. Multiply the summs of each particular payment by its respective Time; then add the several Products together, and their summ divide by the total Debt, and the Quotient thence arising is the equated Time for the payment of the whole Debt. Example,

Quest.

Quest. 1. A is indebted to B in the summ of 130 *l.* whereof 50 *l.* is to be paid at 2 Months, and 50 *l.* at 4 Months, and the rest at 6 Months; now they agree to make one payment of the total Summ, the Question is, what is the equated Time for payment, without damage to Debtor or Creditor?

To resolve this Question I multiply each payment by its Time, *viz.*

50 *l.* *Multiplied by 2 Months produceth* —— 100
50 *l.* *Multiplied by 4 Months produceth* —— 200
30 *l.* *Multiplied by 6 Months produceth* —— 180
The summ of the Products is —— 480

Then I divide 480 (the summ of the Products) by 130 (the total Debt,) and the Quotient is $3\frac{9}{13}$ Months for the Time of paying the whole Debt.

Quest. 2. A Merchant hath owing him 1000 *l.* to be paid as followeth, *viz.* 600 *l.* at 4 Months, 200 *l.* at 6 Months, and the rest (which is 200 *l.*) at 12 Months; and he agreeth with his Debtor to make one payment without damage to Debtor or Creditor?

600 *l.* *Multiplied by 4 Months is* —— 2400
200 *l.* *Multiplied by 6 Months is* —— 1200
200 *l.* *Multiplied by 12 Months is* —— 2400
The summ of the Product is —— 6000

and

and the summ of the Products (6000) being divided by the whole Debt (1000 *l.*) quotes 6 Months for the Time of payment of the whole Debt.

3. The truth of this Rule is thus manifest; if the Interest of that Money which is paid (by the equated Time) after it is due, be equal to the Interest of that Money which (by the equated time) is paid so much sooner than it is due at any rate *per C.* then the operation is true; otherwise not. Example, In the last Question 600 *l.* should have bean paid at 4 Months, but it is not discharged till 6 Months, (that is 2 Months after it is due;) wherefore its Interest for 2 Months at 6 *per Cent. per Annum* is 6 *l.* and then 200 *l.* was to be paid at 6 Months, which is the equated time for its payment, therefore no Interest is reckoned for it, but 200 *l.* should have been paid at 12 Months, but it is to be paid at 6 Months, which is 6 Months sooner than it ought; wherefore the Interest of 200 *l.* for 6 Months is 6 *l.* (accompting 6 *l. per Cent. per Annum*) which is equal to the Interest of 600 *l.* for 2 Months; wherefore the work is right.

The Proof of the Rule of Equation of Payments.

Quest. 3. A Merchant hath owing him a certain summ to be discharged at 3 equal payments,

payments, *viz.* $\frac{1}{3}$ at two Months, $\frac{1}{3}$ at four Months, and $\frac{1}{3}$ at 8 Months; the Queſtion is, what is the equated time for the payment of the whole Debt?

In Queſtions of this nature (*viz.* where the Debt is divided into equal or unequal parts) each of the parts is to be multiplied by its Time, and the ſumm of the Product is the Anſwer,

$\frac{1}{3}$ *Multiplied by* 2 *Months produceth* $\frac{2}{3}$
$\frac{1}{3}$ *Multiplied by* 4 *Months produceth* $1\frac{1}{3}$
$\frac{1}{3}$ *Multiplied by* 8 *Months produceth* $2\frac{2}{3}$

The ſumm of the Product is $4\frac{2}{3}$

which is $4\frac{2}{3}$ Months for the equated Time of payment.

If inſtead of the Fractions (repreſenting the parts) you had wrought by the Numbers themſelves, (repreſented by thoſe parts,) according to the firſt and ſecond Examples, it would have been the ſame Anſwer; as, ſuppoſe the Debt had been 90 *l.* then $\frac{1}{3}$ of it is 30 *l.* for each payment, *viz.* at 2, 4, and 8 Months, then

30 *l. Multiplied by* 2 *Months produceth* 60
30 *l. Multiplied by* 4 *Months produceth* 120
30 *l. Multiplied by* 8 *Months produceth* 240

The ſumm of the Product is 420

which divided by 90 (the whole Debt) quotieth $4\frac{60}{90}$ or $4\frac{2}{3}$ Months, as before.

P *Queſt.* 4.

and the summ of the Products (6000) being divided by the whole Debt (1000 *l.*) quotes 6 Months for the Time of payment of the whole Debt.

The Proof of the Rule of Equation of Payments.

3. The truth of this Rule is thus manifest; if the Interest of that Money which is paid (by the equated Time) after it is due, be equal to the Interest of that Money which (by the equated time) is paid so much sooner than it is due at any rate *per C.* then the operation is true; otherwise not. Example, In the last Question 600 *l.* should have bean paid at 4 Months, but it is not discharged till 6 Months, (that is 2 Months after it is due;) wherefore its Interest for 2 Months at *6 per Cent. per Annum* is 6 *l.* and then 200 *l.* was to be paid at 6 Months, which is the equated time, for its payment, therefore no Interest is reckoned for it, but 200 *l.* should have been paid at 12 Months, but it is to be paid at 6 Months, which is 6 Months sooner than it ought; wherefore the Interest of 200 *l.* for 6 Months is 6 *l.* (accompting 6 *l. per Cent. per Annum*) which is equal to the Interest of 600 *l.* for 2 Months; wherefore the work is right.

Quest. 3. A Merchant hath owing him a certain summ to be discharged at 3 equal payments,

payments, *viz.* $\frac{1}{3}$ at two Months, $\frac{1}{3}$ at four Months, and $\frac{1}{3}$ at 8 Months; the Queſtion is, what is the equated time for the payment of the whole Debt?

In Queſtions of this nature (*viz.* where the Debt is divided into equal or unequal parts) each of the parts is to be multiplied by its Time, and the ſumm of the Product is the Anſwer,

$\frac{1}{3}$	*Multiplied by* 2 *Months produceth*	$\frac{2}{3}$
$\frac{1}{3}$	*Multiplied by* 4 *Months produceth*	$1\frac{1}{3}$
$\frac{1}{3}$	*Multiplied by* 8 *Months produceth*	$2\frac{2}{3}$
	The ſumm of the Product is	$4\frac{2}{3}$

which is $4\frac{2}{3}$ Months for the equated Time of payment.

If inſtead of the Fractions (repreſenting the parts) you had wrought by the Numbers themſelves, (repreſented by thoſe parts,) according to the firſt and ſecond Examples, it would have been the ſame Anſwer; as, ſuppoſe the Debt had been 90 *l.* then $\frac{1}{3}$ of it is 30 *l.* for each payment, *viz.* at 2, 4, and 8 Months, then

30 *l.*	*Multiplied by* 2 *Months produceth*	60
30 *l.*	*Multiplied by* 4 *Months produceth*	120
30 *l.*	*Multiplied by* 8 *Months produceth*	240
	The ſumm of the Product is	420

which divided by 90 (the whole Debt) quotieth $4\frac{60}{90}$ or $4\frac{2}{3}$ Months, as before.

Queſt. 4. A Merchant oweth a ſumm of Money to be paid ½ at 5 Months, and ¼ at 8 Months, and ¼ at 10 Months, and he agreeth with his Creditor to make one total payment; I demand the Time, without damage to Debtor or Creditor? Work as in the laſt Queſtion, and you will find the Anſwer to be 7 Months.

Queſt. 5. A is indebted to B 640 *l.* whereof he is to pay 40 *l.* preſent Money, and 350 *l.* at 3 Months, and the reſt (*viz.* 250 *l.*) at 8 Months, and they agree to make an equated Time for the whole payment; now I demand the Time?

In Queſtions of this nature (*viz.* where there is ready Money paid) you are (in multiplying) to neglect the Money that is to be paid preſent, and work with the reſt as is before directed, and divide the ſumm of the Products by the whole Debt, and the Quote is the Anſwer: For here 40 *l.* is to be paid preſent, and hath no time allowed, and according to the Rule it ſhould be multiplied by its Time, which is 0; therefore 40 times 0 is 0, which neither augmenteth nor diminiſheth the Dividend; wherefore (to proceed according to direction) I ſay,

35[illegible]

350 *by* 3 *Months produceth*——1050
250 *by* 8 *Months produceth*——2000

The summ of the Product is 3050

which divided by 640, the whole Debt, the Quote is $4\frac{49}{64}$ Months, the time of payment.

Quest. 6. A is indebted to B in a certain summ, $\frac{1}{2}$ whereof is to be paid present Money, $\frac{1}{3}$ at 6 Months, and the rest at 8 Months; now I demand the equated Time for the payment of it all?

Answer, $3\frac{1}{3}$ Months is the time of payment.

Quest. 7. A is indebted to B 120 *l.* whereof $\frac{1}{3}$ is to be paid at 3 Months, $\frac{1}{4}$ at 6 Months, and the rest at 9 Months; what is the equated Time for the payment of the whole summ?

Answer, At $6\frac{1}{4}$ Months.

Quest. 8. A is indebted to B 420 *l.* which is due at the end of 6 Months, but A is willing to pay him 140 *l.* present, provided he can have the remainder forborn so much the longer, to make satisfaction for his kindness; which is agreed upon: I desire to know what time ought to be allotted for the payment of the 280 *l.* remaining?

To resolve this Question, first, find out what is the Interest of 140 *l.* for the time it

was paid before it was due, at 6 *per Cent.* (or any other rate) (*viz.* 6 Months,) and you will find it to be 4 *l.* 4 *s.* Then it is evident that the remaining 280 *l.* must be detained so much longer than 6 Months, as the while it may eat out that Interest, *viz.* 4 *l.* 4 *s.* which is thus found out, *viz.* First, see what is the Interest of 280 *l.* for a Month, or any other time; but here we will take 1 Month, and its Interest, for 1 Month is 28 *s.*

Then, by the Rule of Three, say,

As 28 *s.* is to 1 Month, so is 84 *s.* to 3 Months; so that the 280 *l.* remaining must be kept 3 Months beyond its first time of payment, (*viz.* 6 Months;) which added thereto, makes 9 Months; at the end of which time A ought to make payment of the remainder.

CHAP.

CHAP. XX.

Exchange.

1. THE Rule of Exchange informeth Merchants how to Exchange Moneys, Weights, or Measures of one Country into (or for) the Moneys, Weights, or Measures of another Country, and when the Rate, Reason, or Proportion betwixt the Money, Weights, or Measures of different Countreys is known, it will not be difficult for the Practitioner that is well acquainted with the Rule of Proportion (or Rule of Three) to solve any Question, wherein it is required to Exchange a given quantity of the one kind, into the same value of another kind.

2. In Questions of Exchange, there is always a comparison made between the Coyns, *&c.* of two Countries, (or kinds,) or of more.

3. In Questions where there is a Comparison made between two things, (whether they be Moneys, Weights, *&c.*) of

different kinds or (Countries) there may be a solution found by a single Rule of 3, as may appear by the following Example.

Quest. 1. A Merchant at *London* delivered 370 *l. Sterling*, to receive the same at *Paris* in *French* Crowns, the Exchange $3\frac{1}{3}$ *French* Crowns *per* Pound *Sterling*. I demand how many *French* Crowns ought he to receive?

In placing the Numbers, observe the 6th Rule of the 10th Chapter; which being done, the given Numbers will stand thus,

l.	Crowns	l.
1	$3\frac{1}{3}$	370

and being reduced according to the Rules of the 24th Chapter, will stand thus,

	l.		Crowns		l.		Crowns
As	$\frac{1}{1}$	is to	$\frac{10}{3}$	so is	$\frac{370}{1}$	to	$1233\frac{1}{3}$

So that I conclude, he ought to receive $1233\frac{1}{3}$ *French* Crowns at *Paris* for his 370 *l.* delivered at *London*.

Quest. 2. A Merchant delivered at *Amsterdam* 587 *l. Flemish*, to receive the value thereof at *Naples* in Ducats, the Exchange $4\frac{4}{5}$ Ducats *per l. Flemish*. I demand how many Ducats he ought to receive?

The Proportion is as followeth,

	l.		Ducats		l.		Ducats
As	$\frac{1}{1}$	is to	$\frac{24}{5}$	so is	$\frac{587}{1}$	to	$2817\frac{3}{5}$

So I find he ought to receive $2817\frac{3}{5}$ Ducats at

at *Naples* for the 587 *l. Flemish* delivered at *Amsterdam.*

Quest. 3. A Merchant at *Florence* delivereth 3478 Ducatoons, to receive the value at *London* in Pence, the Exchange $53\frac{1}{2}$ Pence *Sterling per* Ducatoon: I demand how much *Sterling* he ought to receive?

The Proportion for Resolution is,

$$\text{As } \overset{\text{Duc.}}{\tfrac{1}{1}} \text{ is to } \overset{\text{d.}}{\tfrac{107}{2}} \text{ so is } \overset{\text{Duc.}}{\tfrac{3478}{1}} \text{ to } \overset{\text{d.}}{186073}$$

which is equal to 775 *l.* $6\frac{1}{12}$ for the Answer.

I might here (according to the custom of Arithmetical Writers) lay down Tables for the Reduction of Foreign Coyns to *English*; but by reason of their Instability, (for they continue not as a constant Standard, as our *Sterling* Money doth; but are sometimes raised, and sometimes depressed,) I shall forbear.

4. When there is a Comparison made between more than two different Coyns, Weights, or Measures, there ariseth ordinarily two different cases from such a comparison.

1. When it is required to know how many pieces of the first Coyn, Weight, or Measure, are equal in value to a known Number of pieces of the last Coyn, Weight, or Measure.

2. When it is required to find out how many pieces of the last Coyn, Weight, or Measure, are equal in value to a given Number of the first sort of Coyn, Weight, or Measure.

An Example of the first Case may be this, VIZ.

Quest. 4. If 150 Pence at *London* are equal to 3 Ducats at *Naples*; and $4\frac{4}{5}$ Ducats at *Naples* make $34\frac{1}{2}$ Shillings at *Brussels*; then how many Pence at *London* are equal to 138 Shillings at *Brussels*? *Facit* 960 *d.*

This Question may be resolved at two single Rules of Three; for first I say,

If 3 Ducats at *Naples* make 150 Pence at *London*, how many Pence will $4\frac{4}{5}$ Ducats make?

Answer, 240 Pence.

By the foregoing Proportion, we have discoverd that $4\frac{4}{5}$ Ducats at *Naples* make 240 Pence at *London*: And by the Tenour of the Question we see that $4\frac{4}{5}$ Ducats at *Venice* make 3-$\frac{1}{2}$ Shillings at *Brussels*; therefore 240 Pence at *London* are equal to 3,$\frac{1}{2}$ Shillings at *Brussels*, (for the things that are equal to one and the same thing, are also equal to one another;) wherefore we have a way laid open to give a solution to this Question

Question by another single Rule of Three, whose Proportion is,

As $34\frac{1}{2}$ Shillings at *Brussels* is to 240 Pence at *London*; so is 138 Shillings at *Brussels* to 960 Pence at *London*, which is the Answer to the Question.

An Example of the second Case may be thus, VIZ.

Quest. 5. If 40 *l.* Averdupois Weight at *London* is equal to 36 *l.* Weight at *Amsterdam*; and 90 *l.* at *Amsterdam* makes 116 *l.* at *Dantzick*; then how many Pounds at *Dantzick* are equal to 112 *l.* of Averdupois Weight at *London*?

Answer, $129\frac{23}{25}$ Pounds at *Dantzick*.

This Question is likewise answered at two single Rules of Three, *viz.* First, I say,

As 36 *l.* at *Amsterdam* is to 40 *l.* at *Lond.*
So is 90 *l.* at *Amsterdam* to 100 *l.* at *Lond.*

And by the Question you find that 90 *l.* at *Amsterdam* is 116 *l.* at *Dantzick*; and therefore 100 *l.* at *London* is likewise equal thereunto; wherefore again I say,

As 100 *l.* at *Lond.* is to 116 *l.* at *Dant.*
So is 112 *l.* at *Lond.* to $129\frac{23}{25}$ at *Dant.*

By which I find that $112\frac{23}{25}$ *l.* at *Dant.* are equal to 112 *l.* Averdupois Weight at *Lond.*

5. There is a more speedy way to resolve such Questions as are contained under the two Cases before mentioned, laid down by Mr. *Kersey*, in the 3d. Chapter of his Appendix to Mr. *Wingate*'s Arithmetick; where he hath given two Rules for the resolution of the questions pertinent to the two said Cases.

6. But I shall lay down a general Rule for the resolution of both Cases; and first, let the Learner observe the following Directions in placing of the given Terms, *viz.*

7. Let there be made two Columns, and in these Columns so place the given Terms one over the other, as that in the same Column there may not be found two Terms of the same kind one with the other.

Having thus placed the Terms, the general Rule is,

Observe which of the said Columns hath the most Terms placed in it, and multiply all the Terms therein continually, and place the last Product for a Dividend; then multiply the Terms in the other Column continually, and let the last Product be a Divisor; then divide the said Dividend by the said Divisor, and the Quotient thence arising is the Answer to the Question.

So the Example of the first of the said cases being again repeated, *viz.* if 150 Pence at *London* make 3 Ducats at *Naples*, and 4

Ducats

Ducats at *Naples* make 34 ½ Shillings at *Brussels*, then how many Pence at *London* are equal to 138 Shillings at *Brussels*?

The Terms, being placed according to the 7*th.* Rule, will stand as followeth:

	A	B	
Pence at Lond.	150	3	*Ducats at Na.*
Ducats at Na.	$4\frac{4}{5}$	$34\frac{1}{2}$	*Shill. at Bruss.*
Shill. at Bruss.	138		

having thus placed the Terms, that in neither Column there is two Terms of one kind, then observe that the Column under A hath most Terms in it; therefore they must be multiplied together for a Dividend, *viz.* 150 multiplied by $4\frac{4}{5}$ produceth $\frac{3600}{5}$ which multiplied by 138, produceth $\frac{496800}{5}$ for a Dividend, then in the Column under B there are 3 and $34\frac{1}{2}$, which multiplied together, produce $\frac{207}{2}$ for a Divisor; then having divided $\frac{496800}{5}$ by $\frac{207}{2}$, the Quotient is 960 Pence for the Answer, as before.

Again, let the Example of the second Case be again repeated, *viz.* If 40 *l.* *Averdupois* Weight at *London* make 36 *l.* Weight at *Amsterdam*, and 90 *l.* at *Amsterdam* make 116 *l.* at *Dantzick*; then how many pounds at *Dantzick* are equal to 112 *l.* *Averdupois* Weight at *London*?

The

5. There is a more ſpeedy way to reſolve ſuch Queſtions as are contained under the two Caſes before mentioned, laid down by Mr *Kerſey*, in the 3d. Chapter of his Appendix to Mr. *Wingate*'s Arithmetick; where he hath given two Rules for the reſolution of the queſtions pertinent to the two ſaid Caſes.

6. But I ſhall lay down a general Rule for the reſolution of both Caſes; and firſt, let the Learner obſerve the following Directions in placing of the given Terms, *viz.*

7. Let there be made two Columns, and in theſe Columns ſo place the given Terms one over the other, as that in the ſame Column there may not be found two Terms of the ſame kind one with the other.

Having thus placed the Terms, the general Rule is,

Obſerve which of the ſaid Columns hath the moſt Terms placed in it, and multiply all the Terms therein continually, and place the laſt Product for a Dividend; then multiply the Terms in the other Column continually, and let the laſt Product be a Diviſor; then divide the ſaid Dividend by the ſaid Diviſor, and the Quotient thence ariſing is the Anſwer to the Queſtion.

So the Example of the firſt of the ſaid caſes being again repeated, *viz.* if 150 Pence at *London* make 3 Ducats at *Naples*, and 4

Ducats

Ducats at *Naples* make 34 $\frac{1}{2}$ Shillings at *Brussels*, then how many Pence at *London* are equal to 138 Shillings at *Brussels*?

The Terms, being placed according to the 7*th.* Rule, will stand as followeth:

	A	B	
Pence at Lond.	150	3	*Ducats at Na.*
Ducats at Na.	$4\frac{4}{5}$	$34\frac{1}{2}$	*Shill. at Bruss.*
Shill. at Bruss.	138		

having thus placed the Terms, that in neither Column there is two Terms of one kind, then observe that the Column under A hath most Terms in it; therefore they must be multiplied together for a Dividend, *viz.* 150 multiplied by $4\frac{4}{5}$ produceth $\frac{3600}{5}$ which multiplied by 138, produceth $\frac{496800}{5}$ for a Dividend, then in the Column under B there are 3 and $34\frac{1}{2}$, which multiplied together, produce $\frac{207}{2}$ for a Divisor; then having divided $\frac{496800}{5}$ by $\frac{207}{2}$, the Quotient is 960 Pence for the Answer, as before.

Again, let the Example of the second Case be again repeated, *viz.* If 40 *l. Averdupois* Weight at *London* make 36 *l.* Weight at *Amsterdam*, and 90 *l.* at *Amsterdam* make 116 *l.* at *Dantzick*; then how many pounds at *Dantzick* are equal to 112 *l. Averdup.* Weight at *London*?

The

The Terms being disposed according to the *7th.* Rule foregoing will stand thus,

	A	B	
l. at Lond.	40	36	*l. Amsterdam.*
l. at Amst.	90	116	*l. at Dantzick.*
		112	*l. at London*

whereby I find that the Terms under B multiplied together, produce 467712 for a Dividend, and the Terms under A, *viz.* 40 and 90, produce 3600 for a Divisor; and Division being finished, the Quotient giveth $129\frac{3312}{3600}$ Pounds at *Dantzick* for the Answer.

CHAP. XXXI.

Single Position.

1. NEgative Arithmetick, called the Rule of False, is that by which we find out a truth, by Numbers invented or supposed: And this is either single or double.

2. The Rule of single Position is when at once, *viz.* by one False Position, or feigned Number, we find out the true Number sought.

3. In the single Rule of False, when you have made choice of your Position, work it according

according to the tenour of the Queſtion, as if it were the true Number ſought, and if by the ordering of your Poſition you find the reſult either too much or too little, you may then find out the Number ſought by this proportion following, *viz.*

As the reſult of your Poſition is to the Poſition, ſo is the given Number to the Number ſought.

Example,

Queſt. 1. A Perſon having about him a certain Number of Crowns, ſaid, if the 4th, and 3d, and 6th parts of them were added together, they would make juſt 45, now I demand the Number of Crowns he had about him? *Anſwer*, 60 Crowns.

To reſolve this Queſtion I ſuppoſe he had 24 Crowns (or any other Number that will admit of the like Diviſion) now the fourth of 24 is 6, and the third is 8, and the ſixth is 4, all which parts, (*viz.* 6, 8, and 4,) being added together make but 18; but it ſhould be 45; wherefore I ſay by the Rule of Three,

As 18, the ſumm of the parts, is to the Poſition 24; ſo is 45 the given Number to 60, the true Number ſought.

For the fourth of 60 is 15, and the third of 60 is 20, and the ſixth of 60 is 10, which added together make 45.

Queſt. 2.

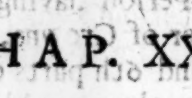
Quest. 2. Three Persons, *viz.* A, B, C, thus discourse together concerning their Age: Quoth B to A, I am as old, and half as old again as you. Then quoth C to B, I am twice as old as you. Then quoth A to them, and I am sure the summ of all our Ages is 165. Now I demand each Man's Age? *Answer*, A 30, B 45, C 90 Years of Age; which added together, make 165.

CHAP. XXXII.

Double Position.

1. THE Rule of Double Position is, when 2 False Positions are assumed, to give a resolution to the Question propounded.

2. When any Question is stated in Double Position, make such a Cross as followeth,



3. Then make choice of any Number you think may be convenient for your working, which call your first Position, and place it at that end of the Cross at *a*; then work with this Position, (as if it were the true Number sought

ſought,) according to the Nature of your Queſtion; then having found out your Errour, either too much or too little, place it on that ſide the Croſs *d*: Then make choice of another Number of the ſame denomination with the firſt Poſition,(which call your ſecond Poſition,)and place it on that ſide of the Croſs at *b*; then work with this Poſition as with the former; and having found out your Error, either too much or too little, place it on that ſide of the Croſs at *c*; and then the Poſitions will ſtand at the top of the Croſs, and the Errors at the bottom, each under his correſpondent Poſition; and then multiply the Errors into the Poſitions croſs-wiſe; that is to ſay, multiply the firſt Poſition by the ſecond Error, and the ſecond Poſition by the firſt Error, and put each Product over its Poſition.

4. Having proceeded ſo far, then conſider whether the Errors were both alike; that is, whether they were both too much, or both too little; and if they are alike, then ſubtract the leſſer Product from the greater, and ſet the remainder for a Dividend; then ſubtract the leſſer Error from the greater, and let the remainder be a Diviſor; then the Quotient ariſing by this Diviſion, is the Anſwer to the Queſtion.

5. But

5. But if the Errors are unlike; that is, one too much, and the other too little; then add the Products of the Positions and Errors together, and their summ shall be a Dividend; then add the Errors together, and their summ shall be a Divisor, and the Quotient arising hence is the Answer; which two last Rules may be kept in memory by this Verse following, *viz.*

When Errors are of unlike kind,
Addition *doth ensue;*
But if alike, Substraction *finds*
Dividing work for you.

Quest. 1. A, B, and C build a House, which cost 76 *l.* of which A paid a certain summ unknown, B paid as much as A, and 10 *l.* over; and C paid as much as A and B. Now I desire to know each Man's Share in that Charge?

Having made a Cross, according to the second Rule, I come, according to the third Rule, to make choice of my first Position; and here I suppose A paid 6 *l.* which I put upon the Cross, as you see; then B paid 16 *l.* (for it is said he paid 10 *l.* more than A,) and C paid 22 *l.* for 'tis said he paid as much as A and B; then I add their parts.

l.		*l.*
9		A 6
19		B 16
28	120 168 288	C 22
	6 X 9	
56	12) (14	*Summ* 44
	32 20	
76	12	76
56		44
20		*error* 32

and they amount to 44; but it is said they paid 76 *l.* wherefore it is 32 too little, which I note down at the bottom of the Cross under its Position, for the first Error.

Secondly, I suppose A paid 9 *l.* then B paid 19 *l.* and C 28 *l.* all which added together make 56; but they should make 76: wherefore the Error of this Position is 20, which I put at the bottom of the Cross, under his Position, for the 2d Error. Then I multiply the Errors and the Positions crosswise, *viz.* 32 (the Error of the first Position) by 9, (the second position,) and the Product is 288. Then I multiply 20 (the Error of the second Position) by 6, (the first Position,) and the Product is 120.

Then (according to the 4*th.* Rule) I subtract the lesser Product from the greater, (*viz.* 120 from 288, because the Errors are

both

both alike *viz.* too little,) and there remaineth 168 for a Dividend; then I ſubtract 20 (the leſſer Error) from 32 (the greater Error,) and the remainder is 12 for a Diviſor; then divide 168 by 12, and the Quotient is 14 for the Anſwer; which is the Share of A in the Payment.

6. Again, Secondly, If the Errors had been both too big, it had had the ſame effect, as appeareth by the following Work; for firſt I ſuppoſe A paid 20 *l.* then B paid 30 *l.* and C 50 *l.* which in all is 100 *l.* but it ſhould have been no more than 76; wherefore the firſt Error is 24 too much. Again, I ſuppoſe A paid 18 *l.* then B muſt pay 28 *l.* and C muſt pay 46 *l.* which in all

20 A		320 432		A 18
30 B		20 X 18		B 28
50 C		8) (14 *facit*		C 46
100 *ſumm.*		24 16		*ſumm.* 92
76 *ſubtr.*		8		*ſubtr.* 76
24 *Error*				*Error* 16

is 92 *l.* but it ſhould have been but 76 *l.* wherefore the ſecond Error is 16 too much; then I multiply 20 (the firſt Poſition) by 16, (the ſecond Error,) and the Product is 320. Again, I multiply 18 (the ſecond Poſition) by 24, (the firſt Error,) and the Product is 432.

Then

Then because the Errors are both too much, I subtract 320 (the lesser Product) from 432 (the greater Product,) and there remaineth 112 for a Dividend ; likewise I substract (16 the lesser Error) from 24 (the greater Error,) and the difference is 8 for a Divisor ; then perform Division, and the Quotient is 14 (as before) for the Answer.

Again, Thirdly, If the Errors had been the one too big, and the other too little, respect being had to the 5*th.* Rule foregoing, the Answer would have been the same ; as thus, I take for my first Position 6, and then the Error is 32 too little; then I take for my second Position 18, and the Error is 16 too much; then I multiply the Positions and Errors cross-wise, and the Products are 96 and 576, and because the Errors are unlike,

96 672 576
6 X 18
48) (14
42 16
48

(*viz.*) one too big, and another too little. I add the Products 96 and 576 together, and their summ is 672 for a Dividend: I likewise add the Errors 32 and 16 together; and their summ is 48 for a Divisor : Then having finished Division, I find the Quotient to be 14,

which

which is the Answer, as was found out at the two several Tryals before.

For proof of the Work I say,

	l.
If A *paid*	14
Then B *paid* 14 *and* 10 (*that is*)	24
Then C *paid* 14 *and* 24 (*that is*)	38
The summ of all is	76

which is the total Value of the Building, and equal to the given Number.

Those who desire to see the demonstration of this Rule, let them read the 7*th*. Chapter of Mr. *Kerseys* Appendix to *Wingate's* Arithmetick, *Petiscus* in the 5*th*. Book of his *Trigonometria*: Or Mr. *Oughtred* in his *Clavis Mathematica*.

Quest. 2. Three Persons, A, B, C, thus discoursed together concerning their Age; quoth A, I am 18 Years of Age; quoth B, I am as old as A, and $\frac{1}{2}$ C; and quoth C, I am as old as you both, if your Years were added together. Now I desire to know the Age of each Person? Answer, A is 18, B is 54, and C is 72 Years of Age.

Quest. 3. A Father lying at the point of Death, left to his three Sons, *viz*., A, B, C, all his Estate in Money, and divided it as followeth; *viz* to A he gave $\frac{1}{2}$, wanting 44 *l*. to B he gave $\frac{1}{3}$, and 14 *l*. over, and to C he gave the Remainder which was 82 *l*. less than

than the Share of B: Now I demand what was the ſumm left, and each Man's part? Anſwer, the ſumm bequeathed was 588*l.* whereof A had 250*l.* B had 210 *l.* and C had 128 *l.*

Queſt. 4. Two Perſons, *viz.* A and B, had each in their hands a certain Number of Crowns; and A ſaid to B, If you give me one of your Crowns, I ſhall have five times as many as you: and ſaid B to him again, If you give me one of yours, then we ſhall each of us have an equal Number: Now I demand how many Crowns had each Perſon? Anſwer, A had 4, and B had 2 Crowns.

Queſt. 5. What Number is that unto which if I add $\frac{1}{4}$ of it ſelf, and from the ſumm ſubtract $\frac{1}{8}$ of it ſelf, the Remainder will be 210? *Anſwer*, 192.

Many more Queſtions may be added, but theſe well underſtood, will be ſufficient (even for the meaneſt Capacity) for the reſolution of any other Queſtion pertinent to this Rule.

There may be an Objection made becauſe we have not treated particularly upon Intereſt and Rebate, but the Operation of ſuch Queſtions being more applicable to Decimals, are omitted, till we come to acquaint the Learner therewith.

Laus Deo Soli.

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